Astronomy

OCT 26 1949

Sky and TELESCOPE

In This Issue:

All Night With the Stars

Crystallization — and the Moon's Surface

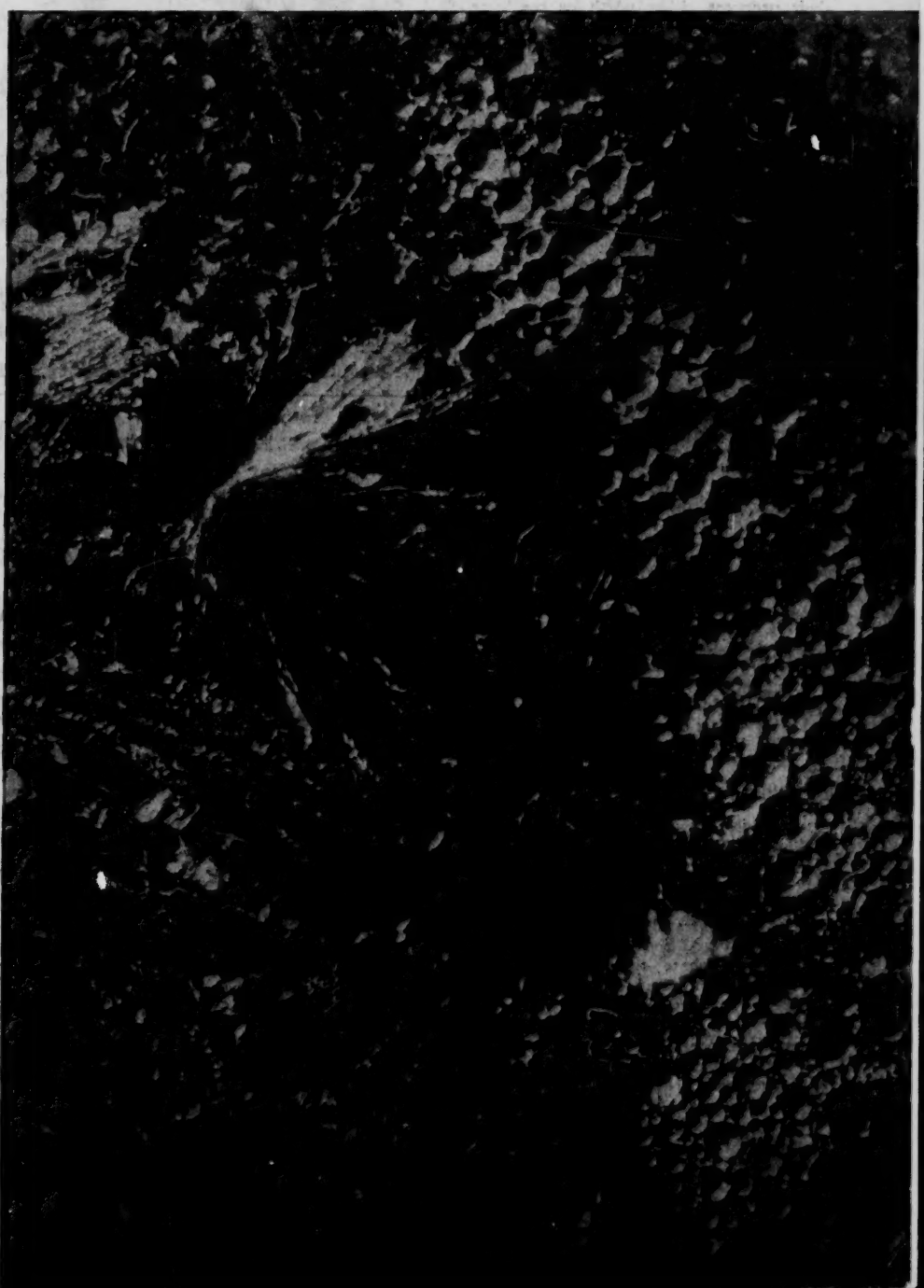
Casting Lead Counterweights

Northern and Southern Star Charts

★

Vol. IX, No. 1
NOVEMBER, 1949
Whole Number 97
25 cents

★



Laboratory craters

LETTERS

Sir:

The eclipse postcards [a reproduction of Mr. Steele's unique card appears here] are just one of those astronomical things I got up to send to friends and acquaintances who I knew were mildly interested in astronomy, with the idea that they might act as missionaries to arouse further interest in the subject. The paths are plotted from the three points given in Oppolzer and, of course, are not exact in the sense of those figured in detail by the Nautical Almanac Office. However, they are not taken from Oppolzer's maps since he simply connects the three points in a curve. Due consideration has been given to the time of year and the location on the earth's surface where the umbral paths fall, together with a study of the previous saros patterns of each eclipse and their progress either north or south as the case may be. They fall close enough to the "exact" path of such things to give an overall picture for the coming decade. At least, I believe, they arouse interest and that was my main purpose.

I am in hearty agreement with the letter from R. D. Cooke in the April, 1949, issue of **Sky and Telescope** (page 138), and believe each club should stress such programs. Again, I think too much emphasis on the detailed construction of telescopes scares many people away who might otherwise be interested in astronomy. After all, there are many fine people who have no interest in, nor ability at, making telescopes, but who are eager to know the constellations and understand the various movements of the stellar spheres. I am for the making of telescopes, but don't like to see that end of it so stressed that there is but little left otherwise.

Star parties in public parks, radio talks, frequent articles in the local papers, and talks on descriptive astronomy to various local clubs appear to me to be fundamental contributions of any astronomy club.

PAUL H. STEELE
Box 935
Sacramento, Calif.

Sir:

Many writers have left accounts of the wondrous northern lights, among them the distinguished English poet, scholar, and historian, John Addington Symonds, whose glowing description in "Clifton and a Lad's Love," written about the middle of the 19th century, perhaps has never been excelled. As it may be of interest to readers of **Sky and Telescope**, I copy most of it herewith:

"Low on the horizon, beyond Durdham Down, were streaks of white light, wavering spokes and flaring lines and streamers flushing into faint rose-pink. Could the buried sunlight still be felt so late into a night of May? Soon, by quiverings and motions in these signs — for the west darkened, and flames burst forth among the topmost stars, and toward the east ran swords, stealthily creeping across the heavenly spaces — I knew that this was an Aurora Borealis. The pageant rapidly developed, and culminated with dramatic vividness. At the very zenith, curving downward to the Great Bear, there

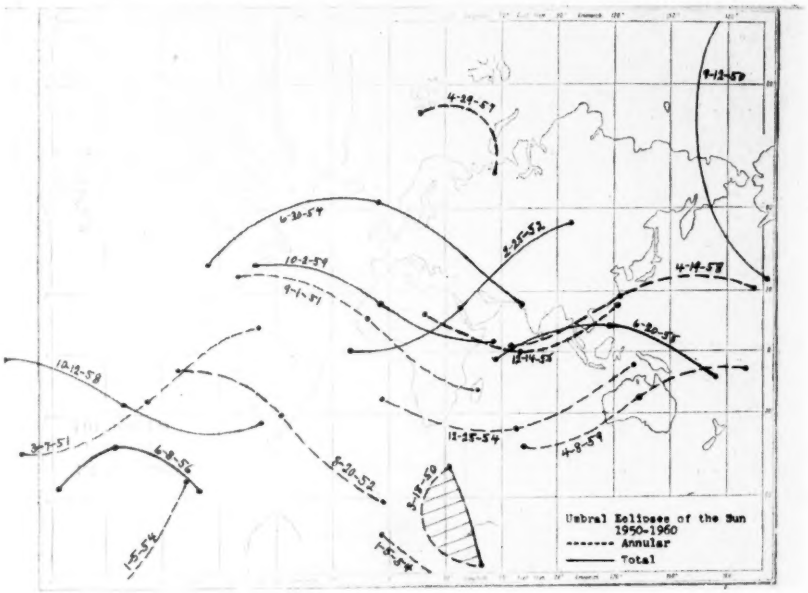
(Continued on page 18)

Sky and TELESCOPE

Copyright, 1949, by
SKY PUBLISHING CORPORATION

CHARLES A. FEDERER, JR., *Editor*; HELEN S. FEDERER, *Managing Editor*

EDITORIAL ADVISORY BOARD: *Clement S. Brainin*, Amateur Astronomers Association, New York; *Edward A. Halbach*, Milwaukee Astronomical Society; *Donald H. Menzel*, Harvard College Observatory; *Paul W. Merrill*, Mount Wilson Observatory; *Charles H. Smiley*, Ladd Observatory; *Percy W. Witherell*, Bond Astronomical Club.



A reproduction of a postcard designed by Paul H. Steele, of Sacramento, Calif.

VOL. IX, NO. 1 NOVEMBER, 1949
WHOLE NUMBER 97

CONTENTS

COVER: Formations of radial rays and miniature craters produced in laboratory experiments by S. I. Gale, F. H. Megson, and associates in the Calco Chemical Division. Photo by Microscopical Laboratory, American Cyanamid Company. (See page 7.)

ALL NIGHT WITH THE STARS — Leland S. Copeland 3

CRYSTALLIZATION — AND THE MOON'S SURFACE

Crystalline Surface Structures of Radial Symmetry — Karl H. Engel 6

Lunar Craters in the Laboratory — S. I. Gale and F. H. Megson 7

CASTING LEAD COUNTERWEIGHTS — D. W. Rosebrugh 15

Amateur Astronomers 8
Books and the Sky 12
Gleanings for ATM's 15
Letters 2
News Notes 10
Observer's Page 19
Planetarium Notes 4
Southern Stars 23
Stars for November 22
Terminology Talks 5

BACK COVER: The northwest corner of the Rosette nebula, which was reproduced in its entirety on the October back cover, photographed with the 48-inch Schmidt telescope on Palomar Mountain. The scale of this enlargement is about 8¾ seconds of arc to one millimeter, or 3½ times larger than last month's picture. The dark spots (mentioned in the "In Focus" of last month) that are so similar to Dr. Bart J. Bok's "globules" are very clearly seen scattered throughout the dark nebulosity. Mount Wilson and Palomar Observatories photograph.

SKY AND TELESCOPE is published monthly by Sky Publishing Corporation, Harvard College Observatory, Cambridge 38, Mass. Entered as second class matter, April 28, 1939, at the Post Office, Boston, Mass., under Act of March 3, 1879; accepted for mailing at the special rate of postage provided in Paragraph 4, Section 538, Postal Laws and Regulations.

Subscriptions: $3.00 per year in the United States and possessions, and to members of the armed services; Canada and all countries in the Pan-American Postal Union, $3.50; all other foreign countries, $4.00. Make checks and money orders payable to Sky Publishing Corporation. Canadian and foreign remittances should be made in United States currency. Circulation manager: Betty G. Dodd.

All notices of change of address must be sent three weeks in advance and accompanied by old and new addresses, or we cannot make the proper change. When sending your renewal order, or writing in regard to your subscription, your current mailing address must be given. For most efficient handling of your subscription, please return our bill form with your renewal payment.

Editorial and advertising offices: Harvard College Observatory, Cambridge 38, Mass. Unsolicited articles and pictures are welcome, but we cannot guarantee prompt editorial attention, nor are we responsible for the return of unsolicited manuscripts unless return postage is provided by the author.

I have known well the assembly of the nightly stars and those shining rulers outstanding in the sky.
—Watchman in Agamemnon *of Æschylus.*

Part of the Santa Ynez Mountains, north of Santa Barbara. La Cumbre (the Summit) is the highest point to the left in the picture. This great barrier of mountains extends for 75 miles. A lunar comparison is the Straight Range in the Sea of Showers, 45 miles. Picture by Royal Photo Supply.

All Night With the Stars

By Leland S. Copeland

BECAUSE we could not take our short-focus telescope to the moon, we drove with it to a mountain summit. We were weary of urban night skies; of electric glare, dust, high fog, and the thick atmosphere of the lowlands. Our goal was a wide-open space on La Cumbre peak, nearly 4,000 feet above the Pacific and next to highest point on the first of the California coast ranges, the Santa Ynez.

In the late afternoon we rode rapidly from Santa Barbara up the long slope, mantled with shrubs and small trees of the Elfin Forest. How smoothly we rolled to the top of San Marcos Pass, over which, more than a century before, John C. Fremont and his men inched forward, dragging cannon over rough slopes, among Eocene and Oligocene rocks, upward, downward, ever onward, until they raised the American flag over Santa Barbara.

From the pass we turned eastward, to climb higher along the back of the range. At sunset we were standing under the lookout on La Cumbre. The forest watchman kindly blanketed the west windows of his tower, to hide his night lamp, that we might look into a truly unobstructed universe.

At once we made ready, placing our telescope near a fence enclosing weather instruments. Our observation point was one minute of time east of the 120th meridian, from which comes Pacific standard time. Fringing our small, lofty clearing grew manzanitas, oaks, and young Coulter trees, which, when mature, produce bigger and heavier cones than any other pines.

Our 4½-inch refractor, Mellish made, features simplicity and portability. As the weight is only 21 pounds, a pedestrian could carry it several miles without becoming unduly tired. The lightness of the aluminum altazimuth mounting makes chains unnecessary between the legs of the tripod, so that one can raise or lower the tube by merely changing the inclination of the legs. As the star hobbyist cannot control city lighting or the evening whims of his neighbors, he is advantaged by using equipment quickly removable to darker locations.

But there we were, aloft on La Cumbre, and day's end was near. The sun, in a ruddy sky, slowly flattened itself into a red-gold line and at last was gone. A moment of sadness followed.

The setting sun will rise again,
The stars will often find the west,
But when for us the brief light dims
There comes a night of endless rest.

Centuries ago lines almost identical with these were penned by the Roman Catullus, who also wrote a colorful poem destined to save for us the Greek story of Coma Berenices. Because Catullus was a pagan, we must tolerate his pessimism. Soon dark thoughts had gone, and our minds paused before another picture, less artistic perhaps, but more comfortable:

The earth's great shadow sweeps around
And ends the fulgent day;
The mountains doff their twilight blue,
The lowlands lose their gray.
But overhead the stars return,
The cloven Milky Way,
And eyes that look through telescopes
Amazing things survey.

Many of us find that to leave bright room and cozy chair for the dark world outside is to act contrary to nature, like a moth flying from the light. As a bather plunges into cold water, so the sky hunter must immerse himself in darkness before he can be comfortable in the night. But he will find it more agreeable to let darkness slowly drift down about him, while he waits at some coign of vantage, such as La Cumbre peak.

Expert astronomers must confine themselves within their workshops, but, oh joy! amateurs are privileged to stand "undir ye cope of hevene," as Wyclif called it; "the wide and starry sky" of Homer and Stevenson. And so rich is this nocturnal wonderland that even for smallest telescopes numerous objects await observation. Just as a bigger city is not always better, despite the opinion of chambers of commerce, so a larger lens or mirror is not an assured benefit. Devotion and patience are as important as light grasp.

Then outward turn an optic tube
From some high, lonely hill,
That we may glance at cosmic nooks
And marvels rich, until
The morning glow conceals those realms
Where precious things distill,
Far-forth beyond the utmost reach
Of human hope and will.

As twilight deepened, we looked at Venus, gibbous, and therefore not yet at her best; not yet a handsome crescent. Jupiter was another early attraction, with one moon on the left and three on the right. But before morning came, one satellite slipped around to join his lonely little brother.

Mercury also was present, but where? He could not be seen as we gazed into the orange and gold of the west. We then tried sweeping with our telescope between Venus and the sun, and we were richly rewarded, for we captured and briefly held the elusive inmost planet.

Out in the west, early night was losing fast some of the main provinces of "the realm of the nebulae." We found M53, a globular, at one corner of Coma Berenices, and four galaxies in Canes Venatici — M51, the Whirlpool; M63, the Sunflower; M94; and NGC 4490 (198[1]), the Cocoon — besides the great globular, M3.

Ursa Major remained on guard all through the night, though the bottom of

the Big Dipper swung below the second of the coast ranges, the San Raphael. To this constellation we were welcomed by the friendly galaxies, M81 and M82, so willing to be admired by amateurs and almost omnipresent for observers. We glimpsed also the great M101 galaxy between Mizar of the Big Dipper and the upper hand of Bootes, and we saw the Owl nebula, M97, very dim in a small telescope.

Among well-known double stars, we briefly examined: γ Virginis, θ Serpentis, γ Arietis, and Albireo of Cygnus. Alcyone in the Pleiades also was pleasing because of the three stars that form a triangle beside it.

Globulars are easy game; even when small they stand out on the stellar scene. We observed M13 and M92, old favorites in Hercules; M14, M10, M12 in Ophiuchus; M4 and M80 in Scorpius; small NGC 5986 ($552^{\triangle}$) in Lupus; M55, M22, M28, and 30^{7} in Sagittarius; NGC 6723 ($573^{\triangle}$) in Corona Australis; M30 in Capricornus; M56, wee thing in Lyra; M15 in Pegasus and M2 in Aquarius and, near dawn, M79 in Lepus.

Treasures in Sagittarius that we held for a few moments were M17, the beautiful Omega nebula; the little cluster M18, and the small starcloud; also M8, the Lagoon nebula and cluster; M20, the Trifid nebula; and its neighbor, cluster M21.

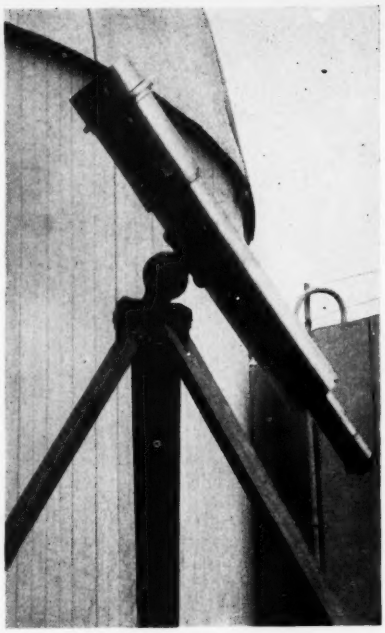
As we doggedly pursued our sky hunt, we could hear the lonely lookout man talking and "cussing" gently to himself, high in his steel tower. Once a faraway fox barked. But the exciting incident of the night came when the telescope, overbalanced, fell more or less on its nose. Luckily the ground was soft.

Of planetaries we saw M57, the Ring, in Lyra; M27, the big Dumbbell, in Vulpecula; M76, the Cork or little dumbbell, in Perseus; M1, the Crab, lurking between the horns of Taurus; and the great Helical in Aquarius, between ι Aquarii and Fomalhaut.

Our galactic game included M31, beautiful in a low-power glass, and its attendants, M32 and NGC 205; M33, the large neighborly universe in Triangulum; NGC 253 (1^{5}) in Sculptor, near globular NGC 288 (20^{6}), which we also found.

So busy were we that there was little time to watch the constellations, but we noticed Grus, looking like a starry sail, and Phoenix, both low in the south. We lunched hastily shortly after midnight. Our schedule, carefully planned for each hour of the night, was disregarded; we depended on the call of the sky itself.

Clusters often are difficult objects to find, or at least to identify, because they frequently lie in rich environments. The shaft of the Northern Cross, a Milky Way starcloud, seems like one huge cluster. But we thought that on its edge, in Vulpecula, we located the handsome



This short-focus Mellish refractor has a tube 32 inches long, and it is easily carried in the trunk of an automobile. It weighs only 21 pounds, including the tripod of aluminum. The instrument has been used in the High Sierras at several points more than 8,000 feet high. Photograph by Charles M. Copeland.

NGC 6940 (8^{7}). Truly, the Double Cluster in Perseus is good for weary eyes; how exquisite it is in a low-power eyepiece! The three great Auriga beauties, M37, M36, and M38, stood out clear; and easy were M11 in Scutum, M35 in Gemini, and M41 in Canis Major. Clusters seen included NGC 7789 (30^{6}), M52, NGC 457 (42^{7}), M103, NGC 663 (31^{6}), all in Cassiopeia; NGC 752 (32^{7}) in Andromeda, M71 in Sagitta, M16 in Scutum, M6 and M7 in Scorpius, and NGC 1746 (21^{7}) in Taurus.

Orion, rising shortly before morning twilight, gave us glimpses of the great nebula, M42, and its companion M43, the fan cluster and nebula about 42, the ι group, and the nebulosity M78.

Altogether we had observed more than 75 objects between 7 p.m. and 4 a.m. While the morning light tinged with gray heliotrope the great valley between the first and second ranges, we rolled contentedly down toward Santa Barbara. To us had come another unusual and pleasurable experience. Face to face, we had communed with Zeus, as both Greeks and Persians called the starry heavens.

At dawn, when soft-gold light enfolds
The drowsy mountain range,
We say goodbye to clustered suns,
To night's unceasing change;
To galaxies and globulars,
For we, by field and grange,
Must hasten home from seeing things
So super-vast and strange.

Planetarium Notes

BALTIMORE: *Davis Planetarium.* Maryland Academy of Sciences, Enoch Pratt Library Building, 400 Cathedral St., Baltimore 1, Md., Mulberry 2370.

SCHEDULE: 4 p.m. Monday, Wednesday, and Friday; Thursday evenings, 7:45, 8:30, 9:30 p.m. Admission free. Spitz projector. Director, Paul S. Watson.

BUFFALO: *Buffalo Museum of Science Planetarium.* Humboldt Parkway, Buffalo, N. Y., GR-4100.

SCHEDULE: Sundays, 2:00 to 5:30 p.m. Admission free. Spitz projector. For special lectures address Elsworth Jaeger, director of education.

CHAPEL HILL: *Morehead Planetarium,* University of North Carolina, Chapel Hill, N.C.

SCHEDULE: Daily at 8:30 p.m.; Saturday and Sunday at 3:00 p.m. Zeiss projector. Director, Roy K. Marshall.

CHICAGO: *Adler Planetarium.* 900 E. Achsah Bond Drive, Chicago 5, Ill. Wabash 1428.

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Sundays, 2:30 and 3:30 p.m. Zeiss projector. Director, Wagner Schlesinger.

LOS ANGELES: *Griffith Observatory and Planetarium.* Griffith Park, P. O. Box 9787, Los Feliz Station, Los Angeles 27, Calif., Olympia 1191.

SCHEDULE: Wednesday and Thursday at 8:30 p.m.; Friday, Saturday, and Sunday at 3 and 8:30 p.m.; extra show on Sunday at 4:15 p.m. Zeiss projector. Director, Dinsmore Alter.

NEW YORK CITY: *Hayden Planetarium.* 81st St. and Central Park West, New York 24, N. Y., Endicott 2-8500.

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30 p.m.; Wednesdays and Fridays, 11 a.m., for school groups. Zeiss projector. Curator, Gordon A. Atwater.

PHILADELPHIA: *Fels Planetarium.* Franklin Institute, 20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Locust 4-3600.

SCHEDULE: Tuesdays through Sundays, 3 p.m.; Saturdays, 11 a.m.; Saturdays, Sundays, and holidays, 2 p.m.; Wednesdays, Fridays, and Saturdays, 8:30 p.m. Zeiss projector. Director, I. M. Levitt.

PITTSBURGH: *Buhl Planetarium and Institute of Popular Science.* Federal and West Ohio Sts., Pittsburgh 12, Pa., Fairfax 4300.

SCHEDULE: Mondays through Saturdays, 2:15 and 8:30 p.m.; Sundays and holidays, 2:15, 3:15 and 8:30 p.m. Zeiss projector. Director, Arthur L. Draper.

SPRINGFIELD, MASS.: *Seymour Planetarium.* Museum of Natural History, Springfield 5, Mass.

SCHEDULE: Tuesdays, Thursdays, and Saturdays at 3 p.m.; Tuesday evenings at 8 p.m.: special star stories for children on Saturdays at 2 p.m. Admission free. Korkosz projector. Director, Frank D. Korkosz.

STAMFORD: *Stamford Museum Planetarium.* Courtland Park, Stamford, Conn.

SCHEDULE: Tuesday and Sunday, 4 p.m. Special showings on request. Admission free. Spitz projector. Director, Ernest T. Ludhe.

TERMINOLOGY TALKS — J. Hugh Pruett

Optics

Our modern science of light and vision surely had its beginnings in simple natural phenomena — if anything in nature may be called simple — which required no laboratory planning by those who observed them. Primitive man learned that by looking into a quiet pool he could see a good likeness of his own face below the surface, and that if he placed one end of a straight stick slantingly into water the stick appeared bent. Perhaps it is slight overpresumption to assume that any highly intelligent fish ever discovered that the setting sun appeared much higher in the heavens when viewed from under water than from the surface. Wherever there were eyes and minds sensitive to color, the rainbow in the spray of the waterfall or the raindrops of a stormy sky or in dewy cobwebbed grass furnished a varitinted arc of mystery.

Reflection

The term *reflection* comes from Latin meaning to bend back. The image of an electric light in a mirror is possible because the rays from the light bend back from the surface and enter our eyes. The eye seems to see the light as far in back of the mirror as it actually is in front of it. It is a well-known principle, taught in high school physics courses, that the *angle of incidence* and the *angle of reflection* are equal. Thus, if a ray of light from a source strikes a surface at an angle of 30° to that surface, it will be reflected from the surface at the same angle of 30°. Actually, the angles of incidence and reflection are 60° each in this case, since they are by definition measured from the perpendicular to the surface at the point where the reflection takes place.

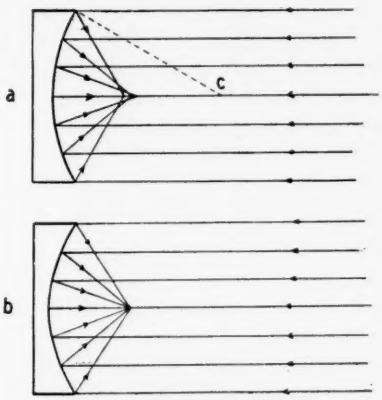
In the case of a light ray that strikes a surface at right angles, that is, perpendicular to the surface, the angles of incidence and reflection are zero, and the ray returns by the same path along which it started.

If the reflecting surface is curved, as in a telescope mirror, the angles of incidence and reflection (i and r) are still equal. The difficulty here, however, may be in determining the perpendicular to any part of the surface. First the tangent to the curve at the point of reflection must be determined, and the angles are measured with respect to the perpendicular to the tangent. The definition of the tangent is beyond our present discussion, but its concept is familiar to everyone in the case of a tangent to a circle.

Telescope Mirrors

A bundle of rays from a very distant object, such as a star, approaches an observer in parallel lines. The purpose of the principal telescope mirror is to collect the rays that strike it and bring them to a point where the bundle of rays may take part in forming an image. This point is known as the *focus* (and lies in the focal surface of the telescope mirror).

Consider part *a* of the diagram to show the cross-section of a concave mirror struck by parallel rays of light from a star. If the curve illustrated is part of a circle and the entire mirror surface part of a sphere with its center at *C*, the reflected rays, all obeying the law of reflection stated above, will be bent back toward the focus but will not cross exactly at one point. This is especially true if the mirror represents a large segment of a sphere, as in the diagram.



Part "a" of this diagram shows the spherical aberration of a spherical reflecting surface. Part "b" shows how the surface of a paraboloid corrects this condition to bring all axial rays to a common focus.

If the cross-section is part of a parabola (see Terminology Talks for March, 1949), as illustrated in part *b*, the entire mirror is a portion of a *paraboloid* (a surface generated by a parabola in rotation about its axis). The reflected rays will all meet at the focus as long as they come in parallel to the principal axis of the mirror, that is, at right angles to the center of the paraboloidal surface. Telescope mirrors are generally given this form.

Focal Length, Focal Ratio

The distance from the center of the mirror to the focus on the central axis is known as the *focal length* of the mirror. The *diameter* of the mirror is the distance across it from one side to the other.

We often see statements that a mirror with a *focal ratio* of f/8 is best for an all-purpose telescope; that f/5 serves well for a wide-angle, "richest-field" instrument; and that f/10, f/12, and higher, are more satisfactory for studying fine planetary detail. These fractions are known as focal ratios. To what do they refer? They seem to be rather incomplete fractions, and it would be simpler for those unversed in optics were they written, for example, F/D = 8. This would mean that the ratio between the focal length of the mirror and its diameter was 8. But in the conventional form the denominators indicate the ratio. Thus, f/8 is correct for a mirror 10 inches in diameter with a focal length of 80 inches, and for one in which these measurements are 30 and 240 inches, respectively.

RAS ASSOCIATE MEMBERSHIP

Dr. Charlotte Moore Sitterly, formerly of Princeton University Observatory and now with the National Bureau of Standards, has been elected an associate of the Royal Astronomical Society of Britain, one of the world's oldest and most distinguished astronomical societies, founded in 1820. Associate membership is from time to time awarded to distinguished foreign astronomers, and Dr. Sitterly is the first woman to have received this distinction, although the late Annie J. Cannon was an honorary member of the RAS. Dr. Sitterly is well known for her work on multiplet tables, solar wave lengths, and her recent volume, *Atomic Energy Levels*.

ASTRO-PHILATELISTS

If your astronomical stamp collection lacks for completeness, an article in the German journal, *Sternenwelt*, published in Munich, should interest you. Seventeen stamps are pictured. The author, Gerhard Schindler, points out that the rising sun occurs most frequently on astronomical postage stamps; he cites 36 solar stamps. The moon is less popular, chiefly represented with a star between its cusps as on the Turkish flag. Stars are also rare, but the Southern Cross and other groups do occur. There are many commemorative series: Galileo in Italy, Copernicus in both Germany and Poland, Tycho in Denmark, and others. Finally is mentioned our own Palomar Observatory stamp.

METEORITES IN RUSSIA

Also in *Sternenwelt*, for August, 1949, there is a brief note attributed to W. G. Fessenkoff concerning the meteorites that fell at a mountain site in Sikhote-Alinsk, southeastern U.S.S.R., on February 12, 1947. The meteorite swarm gouged 120 craters with diameters up to 28 meters; some of the crater profiles have been measured. It is estimated that the total mass may have amounted to 1,000 tons. If all of this material were concentrated in one ball at three times the distance of the moon, it would appear like a planet of the 15th magnitude, the note states. The geographical co-ordinates of the fall are given as 134° 39′.7 east, 46° 9′.6 north.

CRYSTALLIZATION —

Crystalline Surface Structures of Radial Symmetry

By Karl H. Engel

A NOTE by S. I. Gale in the May *Sky and Telescope*, page 174, displayed the photograph of a solidification pattern of an organic substance, and pointed out its general resemblance to lunar craters. Such patterns, although not commonly encountered, are not entirely rare. The present writer, in spare time, has been engaged for the past 10 or 11 years in studying such forms experimentally, as a foundation for a new hypothesis regarding the origin of the moon's surface features. The experimental work here outlined is based on a more comprehensive presentation that is expected to be published in the near future.

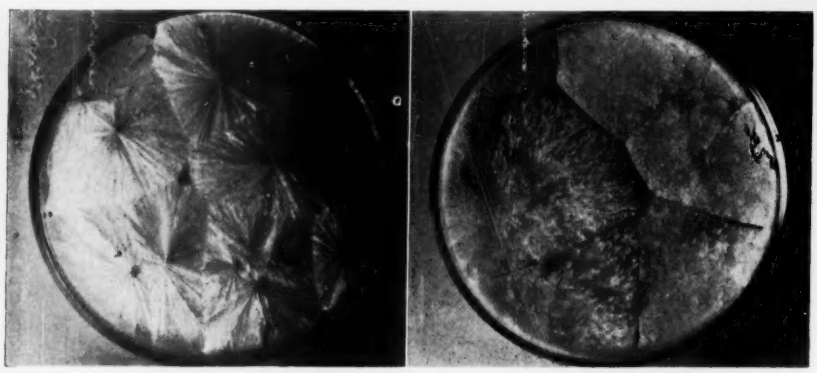


Fig. 1a (left). Radial development in lauryl amine acetate, reproduced about 6/10 natural size.

Fig. 1b (right). Another form of crystalline structure similar to that of Fig. 1a and exhibiting depressions caused by shrinkage at the interfaces, a possible structural feature of planetary surfaces.

We are concerned with the solidification habits of organic substances that have frozen spontaneously from shallow layers of their supercooled melts. Most experiments were carried out in layer depths of from one to 15 millimeters, in 10-centimeter Petri dishes, at or near room temperatures. It is important to note that the forms observed are not directly determined by the characteristic geometrical habits of the individual crystals. The fundamental aggregational pattern, of interest here, is predominantly of two-dimensional radial symmetry.

According to their aggregational behavior, the observed substances can be separated into two classes. Those that form relatively flat stars or centered polygonal plates comprise one class, with numerous examples. The initial center of the form lies either at the surface or else at the bottom of the liquid. The two corresponding examples of this are shown by lauryl amine acetate (melting point 62° centigrade) in Fig. 1. In some of these substances, an initial central aggregate at the surface first develops into a simple cone-shaped cup before sending out its radial beams. To judge from the photograph and description of behavior, the substance observed by Mr. Gale apparently belongs to this kind.

Only a few examples of the second class have been found so far. This group, like the first, starts to develop small submerged stars, hemispheric mounds, or cones. Then, on contact with the surface film, advancing crystals, with a noticeable acceleration of the speed of growth, sprout into bundles of parallel or slightly spreading needles. Single or multiple bundles consolidate into tubules with smaller or greater tendency to flaring. The fibrous bundles or tubules, thereafter, become the intermediate construction units of a radial relief structure that grows more rapidly above than below the surface. The tubule, in the course of growth, need not be preserved but may deteriorate into rudimentary forms: a pointed leaf, a radial rib, or a surface scale. A typical member of this group is an ester, phenyl phthalate (melting point 73° centigrade).

The most interesting material proved to be a related ester, cyclohexyl phthalate (melting point 64° centigrade). The pure substance readily produced cups or pitted surface shields, as shown in Fig. 2. There appeared to be a vague resemblance, especially in group formations, to mountainous areas of the moon. A parallel between the pitted shields and the different types of lunar craters, however, seemed quite indefinite until further search revealed a surprising modification of radial growth that furnished annular relief structure.

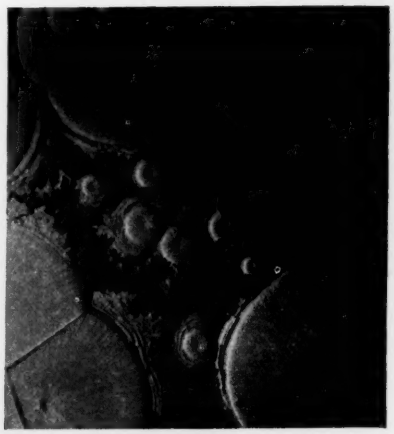


Fig. 2. Cups or pitted surface shields formed with cyclohexyl phthalate, reproduced to a scale about 3/10 natural size. Mr. Engel observed that the ridges in the shields formed by the meeting of already raised edges in the solidifying portions of a shield. Note the cracks among the smaller pitted formations.

In such experiments cyclohexyl phthal-

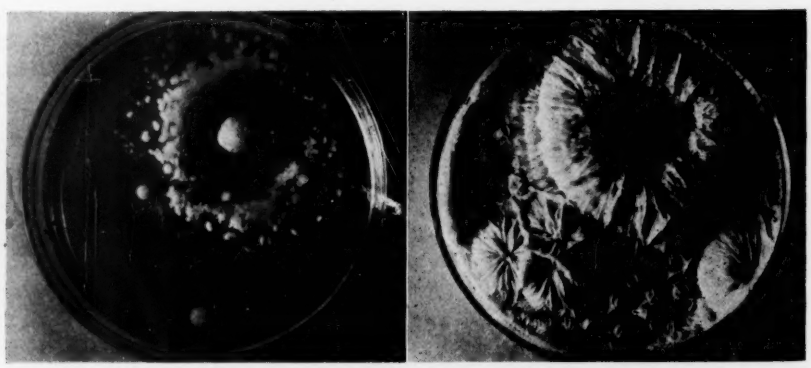


Fig. 3a (left). With modified cyclohexyl phthalate, a halo of crystals was formed in the liquid, reproduced here about 6/10 natural size.

Fig. 3b (right). At a temperature near 32° Fahrenheit, the halo structure developed into a final pattern like that of some regions on the moon.

AND THE MOON'S SURFACE

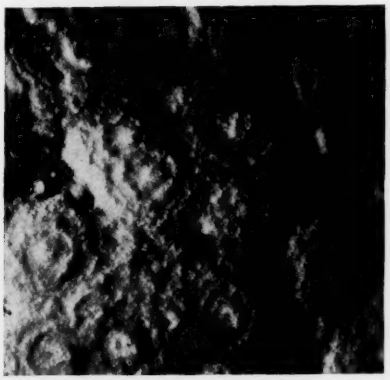


Fig. 4. A close resemblance to the surface of the moon, reproduced about 3/10 natural size. The formation developed at a temperature of 20° centigrade, using such techniques as produced the other structures shown on these pages.

ate was modified by the addition of one half to two per cent of commonly available organic solvents, favorably hydrocarbons or alcohols. In the modified melt, solidification began as usual with a small, submerged mound. Minute detached crystals were produced in a sphere closely adjacent to the growing mound. At a certain stage of development, either before or after emergence of the mound, these crystals were swept away by surface convection currents radiating from the primary growth, until they came to rest, at the eddy, in a floating halo. Extremely faint at first, the halo increased in width and bulk, competing for liquid substance with the parent structure in the center of the ring, as shown in Fig. 3a.

Depending upon a variety of conditions, such as the kind and proportion of solvent addition, layer depth, and temperature level, the material froze in annular structures of more or less distinct relief. Sometimes the primary mound remained visible and at other times became obscured by surface growth, depending on conditions. A crater-like structure produced at a freezing temperature near that of water is seen in Fig. 3b.

A group development that resembles certain lunar features was produced at about 20° centigrade, as shown in Fig. 4. A variety of characteristic and unusual surface features of the moon were simulated in other experiments, such as subsidiary craters and concentric rings. In a more complex process, a group of submerged mounds in a relatively deeper pool of liquid produced ring formations structurally resembling a ring plain or a circular mare, exemplified by Fig. 5.

It may be inferred, on a fairly extensive experimental basis of this kind, that the features of the moon owe their origin to the spontaneous solidification of a relatively shallow layer of supercooled magma. There were no external influences other than tidal forces, which determined regionally different layer depths. The construction material may have followed very closely the solidification habits displayed by cyclohexyl phthalate.

If such reasoning proves applicable to the moon, we might expect that other planetary bodies with undisturbed surfaces had frozen under similar conditions. It is suggested that the relatively flat surface of Mars may find its explanation on the basis of experiments with substances of the first-mentioned class (Fig. 1). The sweeping lines, straight or curved, could be regarded as the common boundaries of extensive surface shields. Larger dark spots might represent pits at meeting points of several boundaries; they are the indications of final shrinkage of material in the process of solidification. Groups of closely spaced smaller spots, on the other hand, might be the darkly tinted or slightly pitted centers of groups of surface shields. Gridlike markings noted by some observers on Mercury might find a similar explanation.

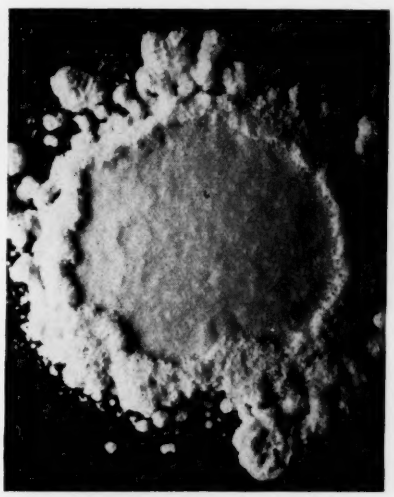


Fig. 5. By following a more complex process than that used to produce the preceding illustrations, Mr. Engel developed the ring formation shown above, resembling a circular mare or a ring plain on the moon. It is about 6/10 natural size.

Turbulent atmospheres on the earth, as on Venus, should have prevented the formation of similar structures on a global scale. Isolated features of this kind perhaps could be found in igneous masses of terrestrial rock that solidified under some protection.

Lunar Craters in the Laboratory

By S. I. Gale and F. H. Megson

SO MUCH INTEREST was aroused in the laboratory craters described in the May issue that we have been encouraged to investigate the oddity further.

The letter described a solidification phenomenon in the laboratory which resulted in the formation of a pockmarked surface similar to that observed on the moon. In testing a series of chemicals, one compound, 2-nitrodiphenylamine, which had been melted and subsequently supercooled, attracted attention by solidifying with crackling sounds and forming a pockmarked surface. Since the manner in which the craters were formed was not observed, further investigation was necessary for a satisfactory explanation.

Attempts to reproduce the original phenomenon have been unsuccessful. Evidently the unusual formation of craters was the result of a fortuitous combination of conditions which was not reproduced in subsequent experiments. There is no doubt that the conditions necessary for the desired result could be reproduced, but to do so at will would require systematic investigation of all the factors involved, such as rate of cooling, degree of supercooling, quality, seeding, and so on. No such project is intended; however, a few isolated experiments have been made with the interesting result shown in the photograph on the front cover.

Seeding with foreign dust-like particles on a supercooled surface consistently resulted in radial crystallization forms, but to date no large central craters have been produced. Bubbles do not appear to be a factor. Soluble impurities added to the material before melting, or to the supercooled surface to produce a localized eutectic area with a lower solidification point, were ineffective. The possibility that radial crystallization would act to concentrate the impurities, producing an area of lower freezing point and different solidification characteristics, was considered but could not be verified.

The nearest approach to the original craters was obtained by heating a few grams of the compounds on a watch glass in an oven to 100-105° centigrade, supercooling for an hour in a desiccator, and initiating the crystallization by placing the watch glass on a layer of flake ice. This technique produces a mixture of

crystal forms, as the front cover shows, which have been reproduced several times and their growth observed. The usual sequence is for radial forms to develop from the bottom first and grow upward and outward. Almost simultaneously a network of fine circular lines appears near the edge of the liquid. These lines become more pronounced until roughly circular crater forms appear. The centers of each become depressed forming a cluster of craters markedly like those on certain areas of the moon. The radial forms grow outward until they meet the cluster forms. Some crackling sounds may be noted. Undoubtedly there are other compounds which will behave similarly, but certain special properties of this compound may be important factors in this phenomenon. For example, it gives off so much heat during solidification that the watch glass containing it becomes hot to the touch. Since the compound melts at about 70° centigrade, remelting of the material in certain localized areas by its own heat of crystallization does not appear impossible. Another property is its high coefficient of expansion; it contracts so much on cooling that it sheers away from the glass. This may account for the crackling sounds.

Most conspicuous in the photograph are the coarse radial lines. These are sometimes much finer, giving a smooth surface corresponding in appearance to the lunar maria. The crater clusters are strikingly similar to those on the moon. Here can be seen a great variety of forms. Some have raised plateaus in their centers, others have tiny craters on their rims. These forms are so divergent that if they had not been observed in the process of formation, they would be believed to have been produced by a variety of causes; yet they appear here as manifestation of one agency, namely, solidification. This suggests that a wide variety of forms could also be possible on the moon. It does not exclude the probability that many lunar craters were formed by meteoric impact or by volcanic action. However, here are craters formed without violent meteoric impact.

This mechanism of crater formation on a sheet of material by surface and subsurface cooling is especially applicable to the moon if one assumes, as has been claimed, that large areas of lunar surfaces were once flooded by seas of molten lava which subsequently solidified by cooling from above and below. Contraction on cooling might be expected to produce cavities of some sort, also cracks in the material and cleavage at the interface just as it did in the laboratory.

It is to be hoped that this discussion will stimulate further interest and contributions from others. The co-operation of Dr. A. G. Hill, Dr. C. Maresh, and Dr. J. H. Thelin is gratefully acknowledged.

Amateur Astronomers

Northwest Region of the League Convenes at Portland

THE NORTHWEST REGION of the Astronomical League held its second annual convention on September 3 and 4, 1949. The building of the Oregon *Journal,* one of Portland's newspapers, was the scene of the greater part of the activities.

The convention began Saturday, the 3rd, with registration from 12:30 to 2:30 p.m. During this same time the exhibits were open in the mezzanine of the building, where instruments, photographs, scrapbooks, and other materials adorned the room. Mr. Haggart, of Oregon City, Ore., displayed a Hindle-type flotation system for his 20-inch telescope. Norman C. Smale, chairman of the exhibits committee, gave a demonstration of grinding on a 10-inch mirror.

The Saturday afternoon session consisted of four papers, including, "Report on the Western Amateur Astronomers Conference," by H. J. Carruthers, of Portland, who had attended the Los Angeles convention. Howard D. Thomas, of Coulee Dam, Wash., spoke on his method of stress-deforming laps. The convention members adjourned to the Central YMCA for the evening banquet, highlighted by good food and wit and humor, the latter ably handled by the presiding officer, Charles G. Benson, past president of the Portland Astronomical Society.

The evening program consisted of three films presented to the public at Library Hall: The Story of Palomar; Solar Prominences, introduced by the Northwest region's solar expert, T. P. Maher, of Arlington, Ore.; and 400 feet of 16-mm. Kodachrome of the 1945 total eclipse, taken by Paul W. Stevens, of the Eastman Kodak Company, and ably introduced by a man who also saw the eclipse, Carl P. Richards, of Salem, Ore., Astronomical League vice-president.

Sunday's events began with a business session at 1:00 p.m. The Northwest region elected the following officers for 1949-50: Edward J. Newman, Yakima, Wash., chairman; Mr. Benson, Portland, Ore., vice-chairman; Traver S. Martin, Yakima, executive secretary; Mr. Smale, Portland, recording secretary; Edward V. Lockhart, Jr.,

THIS MONTH'S MEETINGS

Chicago, Ill.: The annual meeting of the Burnham Astronomical Society is scheduled for Tuesday, November 8th, 8 p.m. at the Chicago Academy of Sciences auditorium. In addition to the business session, The Story of Palomar, shown at the March meeting, will be repeated in compliance with many requests.

Columbus, Ohio: "Meteors and Meteorites" will be the lecture subject at the November 29th meeting of the Columbus Astronomical Society, 8:00 p.m. in Campbell Hall (OSU campus).

Detroit, Mich.: On November 13th, at State Hall, Wayne University, 3:00 p.m., the Detroit Astronomical Society will hear Bertram Donn, of Wayne University, speak on "The Interstellar Medium."

Geneva, Ill.: At the November 8th meeting of the Fox Valley Astronomical Society, George Gelakoski will report on a recent trip to Palomar and other observatories. The meeting is at 8 o'clock in the Geneva City Hall.

Indianapolis, Ind.: Meeting at Cropsey Hall at 2:15 p.m. on November 6th, the Indiana Astronomical Society will hear a talk on "Measuring Starlight" to be given by Walter G. Gingery.

Kalamazoo, Mich.: "Physics of the Ptolemaic System" will be discussed by Dr. John Hornbeck at the November meeting of the Kalamazoo Amateur Astronomical Association, Saturday, November 5th at 8:00 p.m. in the Science Hall of Kalamazoo College. Annual election of officers will also be held.

Los Angeles, Calif.: Dr. Martin Schwarzschild, Princeton University, will tell of a "Journey to the Center of the Sun," before the November 8th meeting of the Los Angeles Astronomical Society, Griffith Observatory, 7:45 p.m.

New York, N. Y.: Dr. B. W. Sitterly, of American University, will speak to the Amateur Astronomers Association on November 2nd, 8:00 o'clock in the American Museum of Natural History (77th St. entrance). His topic is, "Why Must We Live on the Earth."

Pittsburgh, Pa.: On Friday, November 11th, Dr. N. E. Wagman, of Allegheny Observatory, will lecture on "Jupiter, Giant of the Planetary System," to members of the Amateur Astronomers Association of Pittsburgh. The meeting will be at 8:30 p.m. in the Buhl Planetarium lecture hall.

Sacramento, Calif.: An informal get-together is planned for November 1st by the Sacramento Valley Astronomical Society, place to be announced, when those who attended the Los Angeles convention will report. On November 19th, 6 p.m. to 11 p.m., weather permitting, the third field trip to Marshall Monument will be held.

San Diego, Calif.: Professor W. T. Skilling will speak about atmospheres — of the earth, planets, sun, stars, and between the stars, at the November 4th meeting of the San Diego Astronomical Society, 504 Gas and Electric Building.

Washington, D. C.: The National Capital Astronomers will meet on Saturday, November 5th, at 8:00 p.m. in the Commerce Building auditorium. Clyde W. Tombaugh, of White Sands Proving Ground, will speak on "The Ninth Planet, Pluto," which he discovered in 1930.

Yakima, treasurer; James H. Karle, Portland, representative to the Astronomical League council.

Further papers were presented that afternoon, including "A Theory of the Evolution of the Solar System," by Herbert P. Lee, of Portland, and a paper by Mr. Martin on "A Clock for Small Telescopes." Cecil Post, of Portland, presented a paper by Harold Simmonds, of Sacramento, Calif., on a 16-inch tile grinding tool, and related some of his own experiences with ceramic tile tools.

The convention was well attended, drawing the interested members of all clubs, and many strangers who read of it and were interested in seeing the exhibit and in amateur astronomy in general.

JAMES H. KARLE
10925 S. W. 49th Ave.
Portland 19, Ore.

A group of delegates and friends at the convention of the Northwest region of the Astronomical League, assembled at one end of a long balcony. Some of the exhibits show in the picture. Photo by Carl P. Richards.

THE EDITOR OF "ASTRONOMICAL INFORMATION SHEETS" DIES

GILBERT BRUCE BLAIR, professor of physics and astronomy at the University of Nevada, lecturer, writer, churchman, good friend, and exemplary citizen, passed away quietly at his home in Reno, Nev., from an acute heart condition, on September 19, 1949.

He was born in Blairsburg, Iowa, on the 13th of September in 1879, of Scottish and English ancestry, and studied at Tabor College and Washburn College. He did graduate work at the universities of California, Chicago, and Kansas, principally in physics, astronomy, and the classics. At one time he was a fellow at the Lick Observatory, where he no doubt acquired his great love of astronomy which served as a guiding beacon throughout his life.

His teaching experience in astronomy and physics included Washburn University, Allegheny Observatory, Morningside College, Oregon State College, all from 1907 to 1919, when he came to the University of Nevada, to remain for 30 years.

The twilight meteor of November 29, 1945, was one of the most spectacular in meteor history in these parts. It swept in from the Pacific near Santa Barbara, and crossed California in a northeasterly direction, finally disappearing in central Nevada. The meteor received Professor Blair's especial attention. He aided in the plotting of its path, and wrote and lectured about it.

About 1936, Professor Blair organized an association of amateur astronomers, known as the Astronomical Society of the University of Nevada. This group has been continuously active under his direction as president.

Several years ago Professor Blair, who considered himself an amateur astronomer, started regular publication of his "Astronomical Information Sheets." There was a nominal subscription price for 12 mailings, and each of these usually comprised several pages packed with information concerning observing and telescope making. His news and chat and reproductions of portions of letters from his heavy correspondence with other amateurs were particularly well received. The subscription list grew to include amateurs and professionals all over the United States and in many foreign countries.

Finally, it may well be said that his lifework in astronomy was brought to a climax with the first convention of western amateurs held in Los Angeles last August. Professor Blair, whose picture taken at the convention appears on page 309 of last month's *Sky and Telescope*, was the originator of the plan for the convention.

As a man, Professor Blair was possessed of a strong character, kindly, unassuming, but unafraid to express his convictions as he saw them. He was a lover of humanity, a rare soul incapable of the slightest unkindness to his fellow man.

EVERETT W. HARRIS
Vice-president
Astronomical Society of the
University of Nevada

THE INDEX TO VOLUME VIII

of **Sky and Telescope** is on the press. This and the indexes to previous volumes cost 35 cents each, in coin or stamps, or included in the payment of the renewal of your subscription.

BACK ISSUES are available for most numbers. Some are in bound form at $6.50 each volume, postpaid.

SKY PUBLISHING CORPORATION
Harvard College Observatory
Cambridge 38, Mass.

CENTRAL MISSOURI AMATEURS ORGANIZE

For a number of months at irregular intervals, a small group of amateurs within a 50-mile radius of Fayette, Mo., have been meeting informally at the Morrison Observatory of Central College. As time went on it became obvious that formal organization was necessary, and we have now formed the Central Missouri Amateur Astronomers.

Regular meetings will be held at the Morrison Observatory the last Saturday of each month. Our members number 20, most of whom have their own homemade as well as professionally built instruments. Observing programs include variable stars, solar, lunar, and planetary study. We recommend to other cities having only a few amateurs our plan of having membership from the surrounding areas, thus enabling formation of a larger group.

The society was organized through the efforts of Dr. Floyd Helton, Gene Waters, of Jefferson City, and your reporter. The group is indebted to Dr. Helton, director of the observatory, for his interest in formal organization and for the use of the observatory facilities, and we are also fortunate in having as co-councillor Dr. Eli Haynes, director of Laws Observatory of the University of Missouri at Columbia.

The Morrison Observatory was formerly located at Pritchett College, Glasgow, Mo., having been erected there in 1875. The college closed in 1927 and the instruments were purchased by Fayette College. There are a 12-inch Clark refractor, two 4-inch Clark refractors, a 6-inch meridian circle, filar micrometer, spectroscope, and other equipment. In 1935, the present observatory building was erected on a seven-acre tract near the campus; it includes a lecture room and an observing deck in addition to the dome for the 12-inch and a housing for the meridian circle.

Members of our group come from as far away as Jefferson City, Fulton, and Columbia. We invite anyone passing through Missouri to visit our members or attend our meetings.

RUSSELL C. MAAG
611 Bluff St., Fulton, Mo.

NEWS NOTES

By Dorrit Hoffleit

A STRANGE OBJECT

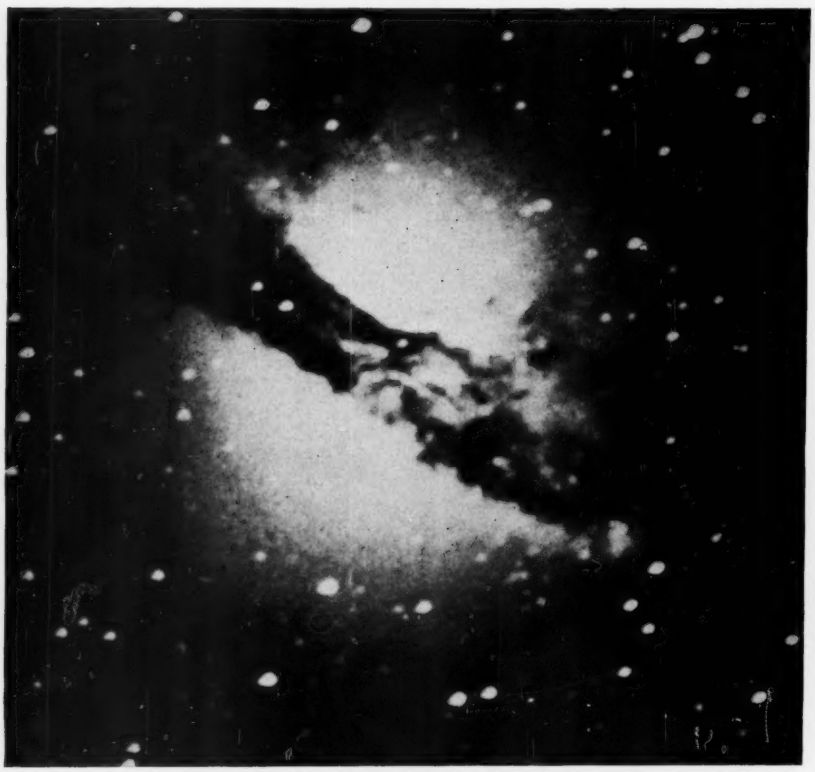
NGC 5128, a luminous object crossed by dark parallel lanes, has long been the subject of controversy: Is it an external galaxy or strictly a local nebulosity? Well-known names are associated with both points of view. Sir John Herschel's remarks implied that he considered the object in a class with the Andromeda nebula. Shapley and Ames classified it as external, while Paraskevopoulos, discussing 5- and 10-hour exposures with the Harvard 24-inch refractor and 60-inch reflector, respectively, concluded in 1935 that its structure refutes the possibility of its being an external galaxy. Hubble at Mount Wilson had earlier found that the object has a gaseous emission spectrum showing the hydrogen lines and the line at 4686 angstroms, but not any of the so-called "nebulium" lines.

In a recent issue of the *Monthly Notices* of the Royal Astronomical Society, David S. Evans, Radcliffe Observatory, Pretoria, South Africa, presents results of a photometric study of the object in both red and blue light. The isophotes, or contours of equal brightness, are approximately circular around the center and the variation of brightness outward is close to that of an inverse square law. This indicates, "if not a strict point source, at least a distribution of sources concentrated in a region which is small compared with the dimensions of the system."

The system of sources is in the same direction as the luminous patches found within the absorbing band. Moreover, the light from this region is reddened. Hence, the author suggests that the object consists of a concentrated source hidden behind obscuring matter and surrounded by a spherical mass of gas, and that it is probably not extragalactic. While its spectrum is not precisely that of a planetary nebula, in other respects there are similarities between it and the planetaries. Similar objects suggested for investigation are I5267 and NGC 1316.

METEORITES IN THE RIM OF METEOR CRATER

Along the rim of Meteor Crater in Arizona are numerous trenches two or three feet deep presumably dug by early exploring expeditions in the search for meteorites. Recently, Dr. H. H. Nininger, of the American Meteorite Museum, has explored about 20 cubic yards of the out-throw from these excavations and recovered 67 metallic meteorites averaging about one-half pound in weight. In addition, about the same weight of oxidized meteorites was found, all by means of a war-surplus mine detector capable of locating a two-pound metallic meteorite at a depth of 24 inches. In *Popular Astronomy* for August, Dr. Nininger, whose permit to explore the crater rim expired before he could complete this phase of his explorations, notes that current construction operations at the crater afford an excellent opportunity to carry out a much more extensive analysis of the contents of the crater rim.



Nebulosity or galaxy? In Dreyer's "New General Catalogue" (NGC), this peculiar object in Centaurus bears the number 5128. Harvard Observatory photo.

VELOCITY OF RADIO WAVES

Do radio waves in vacuum travel with the velocity of light? This has generally been assumed. Yet observations with shoran, a radio-wave pulse system for determining distances, now indicate a value of 299,792 kilometers per second, or 16 kilometers per second greater than the best accepted value for the velocity of light. Distances ranging from 67 to 367 miles were measured by shoran (frequency 93,109.5 cycles per second) and compared with first-order standard triangulations.

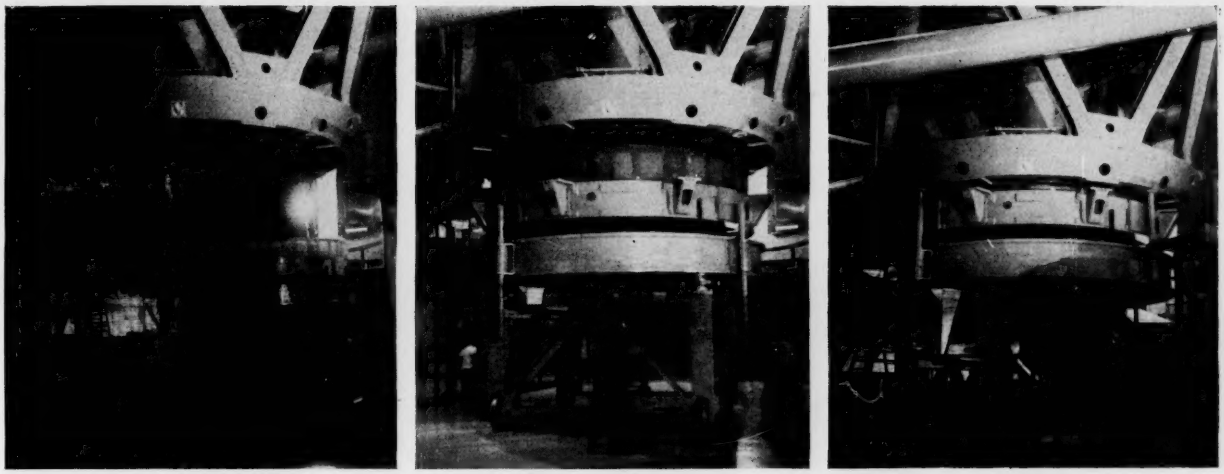
In the *Transactions* of the American Geophysical Union, Carl I. Aslakson, of the U. S. Coast and Geodetic Survey, lists numerous sources for possible discrepancies in the results. The only one that would account for the systematic differences is a possible error in the velocity of electromagnetic propagation. British observers, with a system called "Oboe," have found a similar difference of from 13 to 20 kilometers per second.

By means of shoran very large distances can conveniently be measured with a high degree of internal consistency, promising observational precision greater than published results of previous velocity of light measurements.

MORE TRIPS TO THE MOON, BY 1960

Newspapers of late have been full of contemplated trips to the moon. One scientist at Frankfurt, Germany, Dr. Heinz Gartmann, has been quoted as saying, "All we need now is the chance — and the financial aid — to put our theories into practice." It is stated that half the battle, the completion of basic theoretical calculations for the design of the moon rocket, has been won.

On this side of the ocean considerable publicity has come to members of the Canadian Rocket Society at Toronto. Captain E. J. Evans Fox, visiting New York, displayed a blueprint for a 200-foot-long craft driven by nuclear fission with tripod takeoff and landing equipment. He plans the moon as only a stopover point, and revives the economical year and a half Mars-Venus tour that was long ago designated the "Hohmann Round Trip" (see *Rockets,* Willy Ley, 1944). Captain Fox does not



INSTALLING THE 200-INCH MIRROR IN THE TUBE AFTER A POLISHING PERIOD

This sequence of pictures was taken August 25th through the glass window in the visitors' gallery in the 200-inch observatory dome. Left: The mirror and cell are seen in the position on the floor where polishing was carried on. The polishing machinery has been removed after a period of work on the outer zone of the mirror (see "Sky and Telescope," June, 1949, page 190). Center: The carriage is in place under the tube, and workmen put scaffolds around the carriage. Right: The jacks are slowly lifting the mirror into place; note that the gaps between the tube member and the flanged supporting brackets are nearly closed. The final operation is to tighten the bolts in the brackets manually with long-handled wrenches. That evening the dome was opened to start a period of several days temperature equalization to make possible testing of the mirror on the stars. On October 22nd, Mount Wilson and Palomar Observatories announced completion of the polishing on the mirror. Photographs by the editor on Super XX, f/3.5, one second exposure.

worry about the water and oxygen supply for his passengers, indicating that processes are already in use for the recovery of both of these from the products of combustion. And as for food, he says there is room for tons of it. We tend to be skeptical; but Boris Dyke, vice-president of the Canadian Rocket Society, comes into the limelight with more data and even a prediction. In charge of the planning, he is quoted as saying that 1960 is not only a plausible date but the one toward which they are working for their trip to the moon.

While the most time-saving trip would require only 15 hours, plans are for a four-days-each-way trip in an elliptical orbit which would require less fuel by taking advantage of natural gravitational fields. The 1,000-ton ship would itself cost only about five million dollars; but Dyke estimates that hundreds of millions of dollars will first have to be spent on preliminary research and trials.

HIGH-SPEED ORBIT COMPUTING

The huge selective sequence electronic calculator built by the International Business Machines Corporation has recently been tracing the orbits of Jupiter, Saturn, Uranus, Neptune, and Pluto. With current positions of the planets observed to a high degree of accuracy, the machine computes positions for both the past and the future. So far the computations carried out with more than adequate precision in only a few days involved 10 million large multiplications, divisions, and other arithmetic operations. Recording of the results alone requires printing of over 50,000 16-digit numbers.

The program, partly supported by the Office of Naval Research, is being directed by Dr. Dirk Brouwer, Yale University Observatory, Dr. Gerald Clemence, U. S. Nautical Almanac, and Dr. W. J. Eckert, of IBM's department of pure science.

In the CURRENT JOURNALS

THE HIGHEST AIM OF THE PHYSICIST, by Henry A. Rowland, *Physics Today*, September, 1949. A reprint of an address given in 1899 at a meeting of the American Physical Society by its first president, the man whose researches and reflection gratings stimulated much future astrophysical investigation.

A HALF CENTURY OF GLOBULAR CLUSTERS, by Harlow Shapley, *Popular Astronomy*, May, 1949. Another in the series of articles giving comprehensive coverage to various fields of astronomy.

TERRESTRIAL MAGNETISM, by E. C. Bullard, *Physics Today*, September, 1949. A discussion of the several and controversial theories concerning the origin of the earth's magnetic field, by an English geophysicist.

THE APPROACH TO THE ABSOLUTE ZERO OF TEMPERATURE, by John F. Allen, *Scientific Monthly*, July, 1949. "Although it is relatively easy to move up the temperature scale, it is much more difficult to move down, and it becomes progressively more difficult the farther down we get." The article chronicles success to 0.01° absolute, and speculates on further progress.

NON-INSTANTANEOUS OCCULTATION

On June 9th, D. W. Rosebrugh, of Waterbury, Conn., of the American Association of Variable Star Observers, timed the disappearance of Antares behind the moon at from 0.2 to 0.5 second. When he pondered the matter, he realized that the apparent diameter of Antares, about 0″.04, would require an immersion time for this star of about 1/12 second, since the moon moves one second of arc in two seconds of time. The occultation he observed, however, was almost tangential, accounting for a period of immersion of about 1/6 second.

The editor of *The Strolling Astronomer*, where Mr. Rosebrugh's report appears, remarks that of the six stars besides Antares having large angular diameters only Aldebaran is subject to occultation, and its apparent diameter, 0″.02, is only half that of Antares.

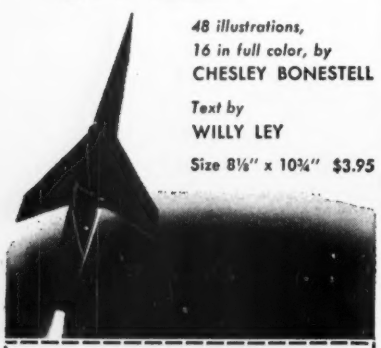
HIMALAYAN STATION

High-altitude research stations are the present vogue, and India is planning one in the Himalayas, according to the journal *Current Science*. Two regions have already been investigated; after a third is studied the choice will be made, among Sikkim, Jumontri, and the Baralacha area. At the station scientists will carry on a snow survey, studies of glaciology, meteorology, astronomy, cosmic rays, mineral resources, and the flora and fauna of the Himalayas. We visualize that such a station could be a great boon to the co-operative plans in the United States and elsewhere for obtaining continuous observations of the night sky.

A breath-taking preview—in text and pictures—of man's next great adventure

TRAVEL BY spaceship at seven miles a second to the mountains of the moon! Visit the planets and their satellites! This book takes you there in exciting text, and in pictures literally "out of this world" and yet scientifically accurate . . . that show what your eyes will behold from the roaring take-off, through outer space, to your close-up view of our solar system. All that rocket science now knows about such a trip and the few problems yet to be solved are graphically set forth to bring this dream of centuries closer to reality for every reader.

THE CONQUEST OF SPACE



48 illustrations, 16 in full color, by CHESLEY BONESTELL

Text by WILLY LEY

Size 8⅛" x 10¾" $3.95

SEND NO MONEY—GUARANTEED "D"

THE VIKING PRESS, 18 E. 48th St., N. Y. 17

Send me THE CONQUEST OF SPACE. I will pay the postman $3.95, plus postage, on delivery. Refund of purchase price guaranteed if I return book within ten days.

☐ Check enclosed. (Send postpaid.)

Name_____

Address_____

City_____ Zone____ State_____

BOOKS AND THE SKY

VOYAGES TO THE MOON

Marjorie Nicolson. The Macmillan Company, New York, 1948. 297 pages. $4.00.

THE AUTHOR of this book is one of the most distinguished scholars of our time. The first woman to hold a full professorship in the Graduate School of Columbia University, she has developed a field of research in English literature that is novel and exciting and that is of particular interest to astronomers. Miss Nicolson decided long ago that a complete knowledge of English literature must necessarily embrace all aspects of its background and must not neglect any single factor that influenced the literary imagination. Admittedly, this sounds so obvious that it may seem almost too simple to be worth stating. For example, have not the major writers in most of the important periods of English literature been affected by the scientific discoveries of their time? Of course they have, but you would not think so by reading most histories of literature, because so little work has been done on the relations of science and literature; the achievements of Miss Nicolson and her pupils stand out to an astonishing degree.

Most of Miss Nicolson's exciting works have thus far appeared in literary journals and serials that are not readily accessible in observatories. Of particular interest to the astronomical reader are: "The Telescope and Imagination" (**Modern Philology,** February, 1935), "The 'New Astronomy' and English Literary Imagination" (**Studies in Philology,** July, 1935), "Milton and the Telescope" (**English Literary History,** April, 1935), "A World in the Moon, A Study of the Changing Attitude Toward the Moon in the 17th and 18th Centuries" (**Smith College Studies in Modern Languages,** January, 1936), "Cosmic Voyages" (**English Literary History,** June, 1940). These titles indicate that, among other things, Miss Nicolson is the astronomer's literary historian; her writings, accurate and well informed, in an engaging style, will revive the interest of more than one astronomer in the subject of English literary history.

Miss Nicolson's most recent book deals with the general subject of lunar travel. It is divided into six major chapters, of which the first discusses the classic prototypes for moon voyages in antiquity: the "Tales" of Lucian, a group of Platonic myths, the "Somnium Scipionis" of Cicero, and Plutarch's "De Facie in Orbe Lunare." Chapter 2 deals with those who described voyaging to the moon by supernatural means, especially in the 17th century. Of greatest interest here is the so-called "dream" written by Kepler which Miss Nicolson describes as the "**fons et origo** of the new genre, a chief source of cosmic voyages for three centuries." The third chapter contains the history of those who attempted to fly with the aid of various kinds of fowls, an idea going back to the ancient mythology of antiquity and especially popular among 17th-century writers, and even those of the 18th. Chapter 4 describes attempts to fly by fashioning wings to human beings, and is followed by a chapter on flying chariots. The final chapter is called "Variations on a Theme," in which one finds everything from an 18th-century electrostatic flying machine to Voltaire's "Micromégas" who was so wonderfully "adept in the laws of gravitation" that he could glide from sphere to sphere as birds hop from one bough to another.

In the course of presenting each traveler who "left the earth for the moon" (and in some cases planets or stars), Miss Nicolson describes for the reader the device chosen for the voyage, and its discussion by various literary authors. At the same time, with a master hand she sets the account against the background of scientific knowledge of the moon and planets which then obtained, indicating the actual scientific sources which were used. Thus this interesting and stimulating book may be thought of at once as a contribution to many different fields—the history of English literature, the history of the human imagination, the prehistory of interplanetary travel and the pre-history of flight in general, the history of the effects of astronomical speculation and astronomical discovery, and the history of science. While most of the book is confined to earlier writers (with the stress being laid on the 17th and 18th centuries), a short epilogue discusses briefly some aspects of the 19th and 20th centuries. I for one was surprised to learn that Miss Nicolson has found, since the time of H. G. Wells, only one writer of interplanetary travel worth discussing, namely, C. S. Lewis, author of "Out of the Silent Planet" and "Perelandra," but mostly known for his literary and theological essays. To discard, by ignoration, the whole body of authors of the exciting compositions that appear in contemporary "astounding" science fiction is perhaps the only element in the book with which anyone could quarrel. It concludes with a most valuable bibliography of the major important works prior to the 19th century which deal with flight or flying, both terrestrial and cosmic.

I. BERNARD COHEN
Harvard University

THREE NEW THEORIES

LAST ICE AGE, illus. 56 pp. **$1.00**
The perplexing riddle of glacial epochs is given an intriguing astronomical solution.

SATURN HAS RINGS, illus. 50 pp. **$1.00**
The rings of Saturn provide convincing evidence supporting a new theory of planetary evolution.

LIFE ON MARS, illus. 50 pp. **$1.00**
Identical to lunar explosion craters, vegetation basins are shown to exist on Mars as canal terminals.

Send postcard for illustrated circular T-1.

DONALD LEE CYR
1412 Palm Terrace, Pasadena 6, Calif.

PRACTICAL SPECTROSCOPY

George R. Harrison, Richard C. Lord, and **John R. Loofbourow.** Prentice-Hall, Inc., New York, 1948. 605 pages. $6.50.

SPECTROSCOPY, like mathematics, has become an invaluable adjunct of almost every branch of pure and applied science. The experimental techniques and underlying theories of modern spectroscopy were developed largely by physicists (with some help by the astronomers). An increasingly large share of current research in spectroscopy, however, is being carried on by scientists concerned with practical applications in biology, chemistry, astronomy, metallurgy, and mineralogy, and in the borderline fields of physical chemistry, biophysics, and so on.

The performance requirements of spectroscopes vary tremendously from one field of application to another and perhaps nowhere as widely as in astronomy. One astronomer may wish to observe far down in the ultraviolet, another in the extreme infrared. The solar astronomer, with a plentiful supply of radiation at hand, will want to work with the highest possible dispersion, perhaps one angstrom per centimeter, whereas the observer of nebular red shifts must be content with a scale of many hundreds of angstroms per millimeter. It is impossible to construct a spectroscope that will be universal; each instrument must be designed for a relatively limited range of application.

Once the spectroscopist has decided on the performance required of his instrument, he must settle many questions before achieving a design that will yield the desired performance. Should he use a prism or a diffraction grating as dispersing element, lenses or mirrors for collimating and focusing? What optical materials should be employed? Should the prisms be made of flint glass, of calcium fluoride, or of thallium bromide iodide? Should the energy detector be a photographic plate, or perhaps a thermocouple or photoelectric cell? What aperture and focal length are most desirable?

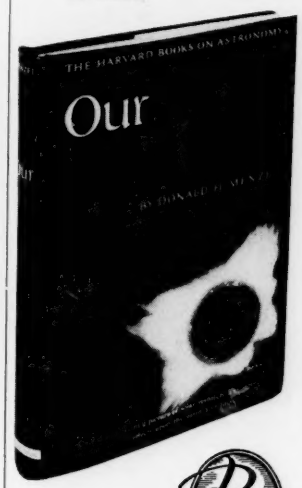
The above questions are but a few of the many that are dealt with fully and authoritatively in **Practical Spectroscopy.** This book is certain to become a standard reference for spectroscopists who are concerned not only with the design of spectroscopic equipment, but also with the intricate details of its practical applications to research and industrial problems. The book synthesizes the points of view of spectroscopic workers in different branches of science, thanks to the distinguished and diversified experience of the three authors. Dean Harrison has been an outstanding figure among spectroscopists for many years. He is especially noted for his invention of ingenious, labor-saving devices for the reduction and analysis of spectra. Professor Lord is a well-known chemist and investigator of molecular structure. Professor Loofbourow has made outstanding contributions in the application of the techniques of absorption spectroscopy to the problems of biophysics. All three are on the faculty of Massachusetts Institute of Technology, and operate the spectroscopy laboratory of that institution.

This reviewer finds it extremely difficult to describe adequately the enormous num-

A GREAT BOOK! **MENZEL "Our Sun"**

A dramatic and entertaining book explaining the basic methods for finding out about the sun. It evaluates and discusses the sun as it affects our natural resources, as a possible source of power, heat and fuel, as it affects radio and weather forecasting; and lastly it explains the correlation between sunspots and the stock market. Certain to become a best seller, Our Sun is a book you can't afford to miss.

178 Illustrations. 326 Pages. $4.50



Have you read these Harvard Books on Astronomy?

Telescopes and Accessories by Dimitroff and Baker — **Earth, Moon and Planets** by Whipple — **Between the Planets** by Watson — **The Story of Variable Stars** by Campbell and Jacchia — **Atoms, Stars and Nebulae** by Goldberg and Aller — **The Milky Way** by Bok and Bok — **Galaxies** by Shapley — (All edited by Harlow Shapley and Bart J. Bok.)

THE BLAKISTON COMPANY
1012 WALNUT STREET PHILADELPHIA 5, PA.

Please send a copy of Menzel's **Our Sun**; my check is enclosed ☐; charge my account ☐. It is understood that you will credit my account in full for the book if I wish to return it within 10 days. Also send me the following Harvard Books .....

.....

Name ..... Address .....

City ..... Zone ..... State .....

ST 11-49

Making Your Own Telescope **The Nature of Cosmic Rays**
Atlas of the Heavens **Sky and Telescope**

Sky Publications

Mappa Coelestis Nova **Splendors of the Sky**
Relativity and Its Astronomical Implications **Moon Sets**

MAKING YOUR OWN TELESCOPE, by Allyn J. Thompson, tells the complete story of how to make and mount a 6-inch reflecting telescope, at very low total cost. Excellent for use by telescope making groups. 211 pages, 104 illustrations. **$3.50**; foreign postage 40 cents

THE NATURE OF COSMIC RAYS, by W. F. G. Swann, gives a review of the fundamental physical and atomic principles involved in the study of this most powerful of all cosmic energies. 32 pages. **50 cents**

ATLAS OF THE HEAVENS, by Antonin Becvar and associates at the Skalnate Pleso Observatory. Sixteen charts cover the entire sky to magnitude 7.75, including doubles, multiples, variables, novae; galactic star clusters, globulars, and planetaries; 1950 co-ordinates. Each chart area is 15½ by 23½ inches. **$5.00**

SKY AND TELESCOPE may be sent as a gift; if requested, a donor's card is sent to the recipient of each gift subscription.

MAPPA COELESTIS NOVA, by Josef Klepesta, is a large wall chart, colorful as well as informative. The northern sky to —45° is shown on a polar projection, and each star is colored according to its spectral class. The chart makes a fine transparency, 28 inches square. **$3.50**

SPLENDORS OF THE SKY is a bargain in astronomical photographs, with explanatory captions, now in its third printing for a total of 36,000 copies in eight years. 36 pages, each 8½ x 11½ inches. **35 cents**, plus 5 cents postage

RELATIVITY AND ITS ASTRONOMICAL IMPLICATIONS, by Philipp Frank, is an outstanding explanation of the general theory of relativity, in language suitable for the layman. 24 pages. **50 cents**

MOON SETS are 18 full-sized plates, nine for the first-quarter moon and nine for the last quarter, from Lick Observatory negatives. Each plate is on a sheet of heavy stock 12 by 18 inches, and there are key charts for named lunar features. **$2.00**

All prices are postpaid except as otherwise noted. Order from your favorite bookstore, from the Adler, Buhl, Fels, Griffith, Hayden, or Morehead Planetarium (see Planetarium Notes for addresses), or write us directly. Payment should accompany all mail orders.

SKY PUBLISHING CORPORATION
HARVARD COLLEGE OBSERVATORY, CAMBRIDGE 38, MASS.

ber of diverse topics that are treated in **Practical Spectroscopy.** The book confines itself to dealing with the problems of the so-called "optical" spectrum, as distinguished from the regions of microwaves, X-rays and gamma rays, which must be studied by entirely different methods. Authors of text or reference books must almost always choose between a complete and detailed treatment of a few selected topics or a brief but comprehensive survey of an entire field. The latter procedure is by far the more difficult one, but in following it the authors have succeeded admirably in treating each topic with sufficient, but not excessive, detail. For completeness, they have also included numerous selected references that make the details readily available to those who wish them. Astronomers will find especially valuable a list of representative manufacturers of spectroscopic equipment at the end of Chapter 2.

The book opens with an introductory chapter that views broadly the methods and accomplishments of spectroscopy as well as its origins. It was inevitable that the development of astronomy and spectroscopy should go hand in hand, since the latter deals with the analysis of light and the universe abounds in interesting light sources. Thus Fraunhofer invented the diffraction grating as an outgrowth of his studies of the spectra of the sun and stars, and Sir William Herschel discovered the infrared region of the spectrum. Chapters 2-4 deal with the design, construction, and relative advantages of various types of prism and grating spectrographs. The authors list four primary performance factors that govern the optimum instrument design for a specific application: (a) the desired wave length range, (b) the dispersion and its variation with wave length, (c) the minimum required resolving power, and (d) the brightness of the spectrum. They then proceed to trace in detail how these and various secondary factors are taken into account in the final choice of instrument design. Chapters 5-7 contain valuable discussions of a multitude of important topics relating to the testing, adjustment, and care of spectroscopic equipment, to the most efficient means of illumination of the spectroscope, and to the special techniques employed in the photography of the spectrum.

Chapter 8 describes the characteristics and relative advantages of many kinds of light sources for spectroscopy, and Chapter 9, the procedures for the measurement and identification of spectrum lines. Chapters 10 and 11 are devoted to a compact and excellent summary of the theory of atomic and molecular structure as it relates to the emission and absorption of radiation by atoms and molecules. The non-physicist will find these chapters extremely useful as background for later chapters dealing with the interpretation of spectral intensities and wave lengths in terms of quantitative analysis and of molecular structure. Chapters 12 and 13 give an up-to-date account of radiometric, photoelectric, and photographic methods for measuring spectral intensities. Chapter 12 will be especially valuable to astronomers who are relying to an increasingly greater extent on radiometric and photoelectric methods for the detection and measurement of radiation.

Chapters 14, 15, and 16 deal with absorption spectrophotometry, and with methods of qualitative and quantitative spectrochemical analysis. The next three chapters are concerned with infrared and Raman spectroscopy, and with spectroscopy of the vacuum ultraviolet. Recent advances in photoconductive and other infrared detectors have heightened interest in infrared instrumentation among astronomers. The final chapter on interferometric spectroscopy will be very useful, in view of the many astronomical applications to the measurement both of accurate wave lengths and line profiles and of solar and stellar magnetic fields.

From the viewpoint of the astronomer, the coverage of the book is not 100-percent complete. No mention is made of the special instrumental problems of stellar and nebular spectroscopy, nor of the many novel astronomical applications of the Schmidt principle to the design of spectrograph cameras. The discussion of the interpretation of absorption-line intensities is also somewhat disappointing. For example, there is no mention of the curve of growth techniques so widely used in astrophysics, and especially by R. B. King for his determinations of relative and absolute f-values for complex atoms.

Practical Spectroscopy is an impressive, up-to-date compilation of spectroscopic "know-how," which should be on the shelf of every astronomer who uses the spectroscope in any of its many forms.

LEO GOLDBERG
University of Michigan Observatory

the Spitz Planetarium

Installations are now in operation at the following places:

U. S. GOVERNMENT

U. S. Naval Academy, Annapolis, Md.
Aero Medical Research Laboratory, Naval Base, Philadelphia, Pa.
U. S. Maritime Academy, Kings Point, N. Y.

MUSEUMS

Boston Museum of Science, Boston, Mass.
Buffalo Museum of Science, Buffalo, N. Y.
Everhart Museum, Scranton, Pa.
Kansas City Museum, Kansas City, Mo.
Maryland Academy of Sciences, Baltimore, Md.
Stamford Museum, Stamford, Conn.

EDUCATIONAL

Alderson-Broaddus College, Philippi, W. Va.
Butler University, Indianapolis, Ind.
Calvert School, Baltimore, Md.
Eastern Mennonite College, Harrisonburg, Va.
Friends Select School, Philadelphia, Pa.
Kansas State College, Manhattan, Kan.
Madison State College, Harrisonburg, Va.
Morgan State College, Baltimore, Md.
Ohio State University, Columbus, Ohio
Pennsylvania State College, State College, Pa.
Phoenix Junior College, Phoenix, Ariz.
Rhode Island State College, Kingston, R. I.
San Francisco City College, San Francisco, Calif.
Stanford University, Palo Alto, Calif.
University of Minnesota, Minneapolis, Minn.
University of Southern California, Los Angeles, Calif.
University of West Virginia, Morgantown, W. Va.
Wayne University, Detroit Astronomical Society, Detroit, Mich.
Western Michigan College, Kalamazoo, Mich.

PRIVATE

Dr. Douglas Kelley, Berkeley, Calif.
Mrs. Olive Grunow, Detroit, Mich.

FOREIGN

Australia: Museum of Technology & Applied Science, Sydney
Canada: Royal Astronomical Society of Canada, McMaster University, Hamilton, Ont.
Egypt: His Majesty, King Farouk, Cairo

SCIENCE ASSOCIATES

401 NORTH BROAD STREET
PHILADELPHIA 8, PA.

GLEANINGS FOR ATM's

EDITED BY EARLE B. BROWN

CASTING LEAD COUNTERWEIGHTS

WHENEVER the writer makes a new telescope mounting, revamps an old one, or changes the weight of equipment carried by a telescope, he seems to be faced with the necessity of making a new counterweight. The following hints may be of value to others who have this problem.

Let us first consider the properties of lead in so far as we are concerned with them. It is possible, but not easy, to saw and drill lead. If lead has to be tapped, it is usually better to let the machine screw itself cut its own thread. Such self-tapped threads will suffice to fasten two lead weights permanently together, but they are not strong enough for the threads of a clamp bolt. From these facts we can conclude that a lead weight should be cast to the weight and shape needed, with all necessary holes in the right positions and of the right sizes. A brass or iron "insert" imbedded in the lead weight is required to take the female threads for any clamp bolt needed.

Once a lead weight is cast, imperfections can be removed by such methods as wiping the surface with a large hot soldering iron, by filing, by peening high spots with a hammer, or by cutting off rough edges with a sharp knife.

One can buy new lead at the plumber's but old lead pipe can be melted down. Cut the pipes with a cold chisel into short hunks suitable for melting. The dirt and oxide will float to the top where it can be skimmed off, but in practice this is usually unnecessary, for the clean molten lead will pour out from beneath the slag, which will remain behind in the melting pot or can.

Lead weighs 0.41 pounds per cubic inch. Plan the exact dimensions and shape you wish your counterweight to be, making allowances for holes. In deciding the weight required, remember that the center of gravity of the weight will be about at the midpoint of its length, not at its outer end. Weigh out the lead you plan to melt. Melt about five to 10 per cent more than you need. There will be losses from slag and leakage and not all will pour out from the melting pot.

The writer usually melts the lead in an old tin can of appropriate size. Weights up to 50 pounds can readily be melted on a gas stove. A few drops of leakage around the bottom of the can will usually occur, but the lead which splashes on the stove can be removed with a finger nail. A cast-iron pot is, of course, better.

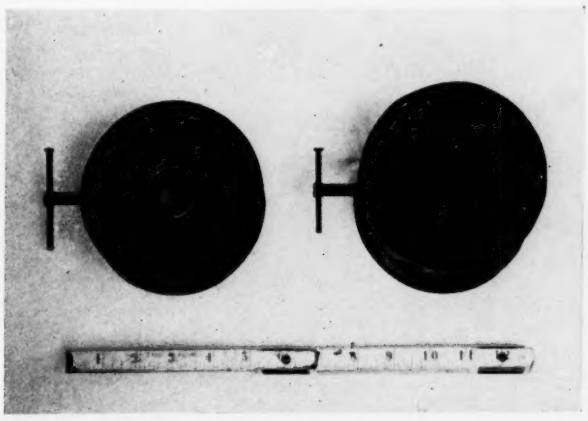
Fifty pounds of lead will melt on a gas stove in an hour. Smaller weights take less time. Do not overheat the lead. When all chunks have melted, it is time to pour. If the molten lead is brought to a higher temperature than necessary, it will cause a wooden mold to smoke badly and to emit fumes which bubble up through the cooling lead, causing gas pockets in it. If the lead is only just above the melting point, it will cool fast enough in the mold to seal any small leaks in the mold which may have occurred inadvertently.

Before starting to pour be sure that the mold is carefully leveled up on a concrete floor. Do not trust your eye; use a level to be sure that it is true; otherwise one side of the lead weight will be thicker than the other.

When pouring the molten lead, use gloves to shield the hands from the heat. Grip the top edge of the can containing the molten lead with a pair of large pliers. Carry it down to the cellar. Distribute the lead around the mold as you pour. It sets fast. Don't be scared. The writer has made some 25 counterweights and has not burned himself or set fire to anything while doing so.

This describes the process of casting, but some further hints on molds will be useful, and on the preparation of the brass or iron insert for the female threads into which the clamping bolt screws.

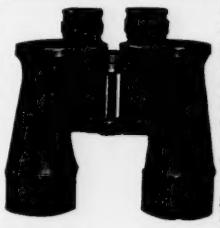
Simple rings are often serviceable to enlarge existing weights. They can be poured in a wooden mold. Turn such a mold on a wood lathe using a piece of board two inches thick and cutting an annular groove in it about three quarters of an inch deep. Allow a little "draw" or taper to the sides so the weight will come out easily when it is cold. Drill the wood mold at three equally spaced points and insert little wooden dowel pins so they will stick up vertically through



Lead counterweights cast by D. W. Rosebrugh for a 6.2-inch refractor. The one on the right weighs 25 pounds and was cast in a tin can. The other is made up of three five-pound rings cast by separate pours in the same mold. Bolts hold the rings together.

WAR SURPLUS BARGAINS
Government's 7 X 50 Binoculars

Assemble Them Yourself! Complete Optics! Complete Metal Parts! Save More Than ½ Regular Cost!



METAL PARTS—Set includes all metal parts—completely finished — for assembly of 7 X 50 Binoculars. No machining required. Sturdy Binocular Carrying Case is optional with each set of Metal Parts.

Stock #842-Y. $39.40 Postpaid, plus $4.80 for Case. Total $44.20

OPTICS–Set includes all Lenses and Prisms needed for assembling 7 X 50 Binoculars. These are in excellent condition — perfect or near-perfect — and have new low reflection coating.
Stock #5102-Y ..... $25.00 Postpaid

Note: These are fine quality standard American-made parts (not Japanese, French or German).

NOTICE! If you buy both Binocular Optics and Binocular Metal Parts, add 20% Federal Tax.

ARMY'S 6 X 30 BINOCULARS

COMPLETE OPTICS & METAL PARTS—Model M-13A1, 6 x 30 Binoculars (Waterproof Model). Everything you need—ready for assembly. When finished will look like regular factory job costing $102 to $120. Optics are new, in perfect or near-perfect condition. Have new low reflection coating. Metal Parts new and perfect, all completely finished. Complete assembly instructions included.
Stock #830-Y ..... $40.00 Postpaid plus $8.00 tax—Total—$48.00

CROSSLINE RETICLE — Dia. 29 mm.
Stock #2036-Y ..... 50c Postpaid

$1200.00 VALUE FOR $95.00

SCISSORS TELESCOPE — Gives 100 times greater stereoscopic power than the unaided eye. Binocular type. Big field of view. 12 power. Furnished complete with tripod, mount and case. Used by Army and Navy for long distance spotting, target observation, etc. Used but good condition. Shipped f.o.b. Camden, N. J. (Weight approx. 79 lbs.).
Stock #952-Y ..... $95.00 Postpaid

PLASTIC HOBBYISTS! — Your chance to get a large, heavy piece of super, optical quality Plexiglas, approx. 1¾" thick, 7½" long, 6½" wide . . . weight, 4 lbs. 5 ozs. Actually a U. S. Army Plexiglas Periscope containing at least $7.00 worth of Plexiglas. Carve it! Saw it! Mold it! Makes numerous plastic novelties.
Stock #725-Y ..... $3.00 each Postpaid
6 or more units ..... $2.75 each Postpaid
12 or more units ..... $2.25 each Postpaid

MOUNTED TELESCOPE EYEPIECE — Kellner type. Excellent astronomical and other telescopes. War Surplus. Government cost about $18.00. Focal length 24 mm. Lens diameter 23 mm. Unusually wide field.
Stock #5189-Y ..... $3.25 Postpaid

ADAPTER MOUNT (not surplus)—2⅛" long with standard 1¼" O.D. for use on astronomical telescopes. Threaded so Stock #5189-Y screws into it. Black anodized.
Stock #5190-Y ..... $1.00 Postpaid

NEW BULLETIN on our BIG VARIETY OF PRISMS—Request Bulletin Y.

FIRST-SURFACE MIRRORS
Stock #539-Y—60 mm. x 80 mm. . . **75c Postpaid**
Stock #558-Y—45 mm. x 74 mm. . . **50c Postpaid**
Stock #547-Y—43 mm. x 140 mm. . . **50c Postpaid**
Stock #534-Y—25 mm. x 29 mm. . . **25c Postpaid**

TELESCOPE EYEPIECE—Consists of 2 Achromatic Lenses, F. L. 28 mm. in a metal mount.
Stock #5140-Y ..... $4.50 Postpaid

SIMPLE LENS KITS!—THE LENS CRAFTERS DELIGHT! Fun for adults! Fun for children! Kits include plainly written illustrated booklet showing how you can build lots of optical items. Use these lenses in photography for copying, ULTRA CLOSE-UP SHOTS, Microphotography, for "Dummy Camera," Kodachrome Viewer, Detachable Reflex View Finder for 35-mm. cameras, Stereoscopic Viewer, ground glass and enlarging focusing aids. And for dozens of other uses in experimental optics, building TELESCOPES, low power Microscopes, etc.
Stock #2-Y—10 lenses ..... **$1.00 Postpaid**
Stock #5-Y—45 lenses ..... **$5.00 Postpaid**
Stock #10-Y—80 lenses ..... **$10.00 Postpaid**

SLIDE PROJECTOR SETS—Consist of all unmounted lenses you need to make the following size projectors:
Stock #4038-Y — 2¼" x 2¼" .... $3.35 Postpaid
Stock #4039-Y — 2½" x 3½" .... $3.35 Postpaid
Stock #4035-Y — 35 mm. ..... $4.85 Postpaid

We Have Literally Millions of WAR SURPLUS LENSES AND PRISMS FOR SALE AT BARGAIN PRICES. Write for Catalog "Y"—FREE!

Order by Stock No. Satisfaction Guaranteed.

EDMUND SALVAGE CO.
BARRINGTON, NEW JERSEY

WAR SURPLUS BARGAIN

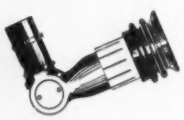
OPTICS

ACHROMATIC TELESCOPE OBJECTIVES — Perfect Magnesium Fluoride Coated and cemented Gov't. Surplus lenses made of finest Crown and Flint optical glass. They are fully corrected and have tremendous resolving power. Guaranteed well suited for Astronomical Telescopes, Spotting Scopes, etc. Gov't. cost approximately $100.00.

Diameter	Focal Length	Each
56 mm (2 3/16")	600 mm (23½")...	$12.50
76 mm (3")	381 mm (15").....	19.00
81 mm (3 3/16")	622 mm (24½")....	22.50
83 mm (3¼")	876 mm (34½")...	28.00
83 mm (3¼")	1016 mm (40")	30.00

40 POWER TELESCOPE Coated Lenses

Precision American Made Variable Power Telescope (not war surplus). FOUR TELESCOPES in One, 10X, 20X, 30X and 40X. Magnesium-fluoride Hard Coated lenses. Achromatic Objective lens 2⅛" (53 mm) dia. Length closed 9½", open 27½". Aluminum and brass construction throughout. Genuine Leather covering. Weight 28 ozs. $42.50

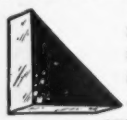


3x ELBOW TELESCOPE — Makes a nice low priced finder. Brand new; has 1" Achromatic Objective. Amici Prism Erecting System, 1⅜" Achromatic Eye and Field Lens. Small, compact, light weight, 2 lbs. Gov't. Cost $200. $6.50

27 POWER SPOTTING SCOPE LENS SET. This set of lenses will make a Spotting Scope comparable in optical quality with scopes priced at $75.00 to $100.00. REMEMBER the lenses are the heart of the instrument. Consists of big 56 mm (2 3/16") dia. Coated Objective Lens, 2 Prisms, Eyepiece Lenses. Instructions. All optics cemented and Perfect or near Perfect ..... Set $16.75

LENS CLEANING TISSUE—Here is a wonderful Gov't. Surplus buy of Lens Paper which was made to the highest Gov't. standards and specifications. 500 sheets size 7½" x 11". $1.00

RIGHT ANGLE PRISMS for photography or astronomical telescopes. The prisms have square faces, some can be supplied with silvering. Write for list "S."



8 mm Face	... ea.	$ .75
23 mm Face	... ea.	1.25
30 mm Face	... ea.	1.75
38 mm Face	... ea.	2.00
47 mm Face	... ea.	3.00

SPECIALS ! ! !

HOBBYIST SET—Fun for Young and Old. 10 assorted lenses and Project Booklet .....ea. $1.00

MAGNIFYING LENS, 2" Dia. Coated .....ea. 1.00

MAGNIFYING LENS, 3" Dia. Coated .....ea. 2.00

7 x 50 BINOCULAR OBJECTIVES, Coated .....ea. 3.75

7 x 50 BINOCULAR PRISM, Coated ea. 2.00

6 x 30 BINOCULAR OBJECTIVE, Coated .....ea. 1.75

6 x 30 BINOCULAR PRISM, Coated ea. 1.50

KELLNER EYEPIECE LENS SET, 22 mm F.L. 2.50

TANK PRISM, Silvered, 5¾" long (slight seconds). Beautiful desk paper weight. 1.00

CONDENSING LENSES (seconds) 4½" Dia. 6½" F.L. 1.00

WE HAVE a large assortment of square and circular heat absorbing glass. Write for prices.

"FREE CATALOGUE"
Sensational Optical Bargains
Send for it TODAY

WE PAY THE POSTAGE
A. JAEGERS 93-08S 95 AVE. OZONE PARK 16, N. Y.

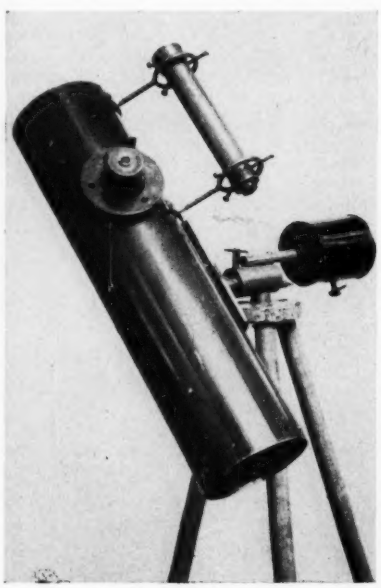
the lead when it is poured. These are to leave holes in the lead weight through which to put bolts to attach the annular ring to the existing counterweight, which must, of course, be drilled and tapped (self-tapped by the screws themselves if it is a lead counterweight) to receive the three bolts. The dowel pins will char and pull out with the lead weight when it comes out of the mold, but they can easily be driven or drilled out. In using the mold again, put in more dowel pins before casting the next weight.

Rectangular counterweights can be cast in a wooden mold. Cut a rectangular hole through a one-inch board. Clamp another board to it for the bottom. Insert dowel pins as required for the holes. Level the mold, and pour as above.

Usually, however, one will be confronted with making an entirely new counterweight of from 10 to 50 pounds, of a cylindrical shape, with a central bore, and a clamp bolt sticking out the side.

The writer keeps a collection of old tin cans on hand for such molds. Choose one of appropriate diameter and height for the weight to be cast. Remove paper labels so they will not char and smoke. On a wood lathe turn a piece of soft wood to the right diameter to serve as a core for the central bore hole. Square up one end of this cylinder in the lathe. Fasten the core in the can so that its axis coincides with that of the can; use an ordinary wood screw up through the bottom of the can. Center and brace the wooden core at the open upper end of the can, either with radial nails, bolts, wire, or in any convenient way. This material will be above the surface of the poured lead and hence will not affect the counterweight.

The most ticklish part of the mold still remains to be made, namely, the metal insert for the female threads into which the clamp bolt will screw. Prepare the clamp bolt first. This is merely so that one knows the size of hole and tap to



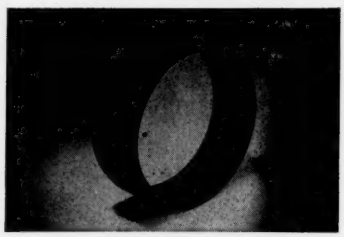
One of Mr. Rosebrugh's telescopes with a lead counterweight in operating position.

A typical all-metal observatory.

ALL - ALUMINUM DOMES

10′ to 20′ diameter with shutters, track, electric drive. Complete observatories priced from $1,000 to $2,000. Inquire

J. O. PAULSON, R. R. 3, Navarre, Ohio



Coated Astronomical Objective
3⅛ inch by 50-inch focal length, air spaced, in black anodized duraluminum barrel.
• Individually hand corrected and figured •
Price $62.00

Dioptric Engineering Laboratories
47 West 56th St., New York 19, N. Y.

ALUMINIZING

HARD BER-AL COATING

Our exclusive high-reflectivity BER-AL coatings are free from chromium and they are not overcoated with fluorides or quartz. They can be removed easily, when desired, without harm to the glass surface below. Prices for BER-AL coatings, f.o.b. Chicago, are: $2.50 for 6" diameter mirrors, $3.50 for 8", $5.00 for 10", and $8.00 for 12½". Larger sizes up to 24" diameter on request.

LEROY M. E. CLAUSING
4544 N. Western Ave. Chicago 25, Ill.

Complete Telescopes
Reflectors and Refractors suitable for universities and private use. All optical parts of the highest quality.

Ramsden Eyepieces
that have satisfied hundreds of buyers.
Equivalent focal lengths ¼", 1/3", ½", ⅔", 1" ..... $5.15 each
1¼", 1½", 2" ..... 10.25 each
All standard 1¼" diameter; postpaid.

FINDERS that can be swung to either side of tube for convenience.

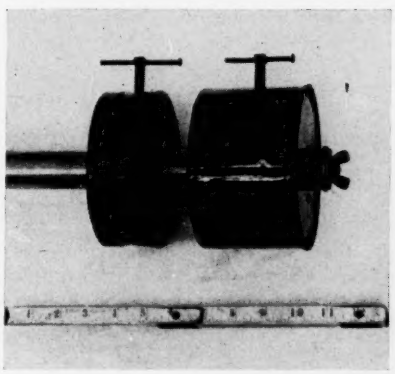
Send for free price list and description on complete Telescopes, Mountings, Combination Eyepiece and Prism Holders, Aluminum Mirror Cells, Star Diagonals, Prisms.

C. C. Young
25 Richard Road East Hartford 8, Conn.

use in the insert. Sometimes the insert can be made of a short section of brass plumbing pipe which one taps internally from end to end and which extends from the center wooden core to the inside of the outer wall of the tin can. Such a brass tube insert should be deeply notched on its outside surface with a file, so it will have a firm bond on the lead. Sometimes it is better to use a short crossbar of metal, drilled and tapped for the clamp bolt and placed up close to the central wooden core. In the latter case, screw a wooden dowel into the cut threads and let this dowel project from the insert to the tin can wall. This is so that a hole will be left in the casting for the clamp bolt, extending from the outer periphery of the weight to the insert. Some little care should be taken to see that the molten lead will not flow into the cut threads of the insert at either end of the hole in the insert. A small amount of leakage is of no great importance. Plastic wood or brown soap in small quantities can be used to make tight fits.

Place the metal insert at such a height above the bottom of the can that it will be about the midpoint of the counterweight longitudinally when it is poured. Fasten the insert securely to the wooden core and to the can mold with brads, screws, or in any appropriate manner. Sometimes a tight fit is all that is needed to hold it in place until it has become imbedded in the lead.

Pour the weight and let it cool. Use a cold chisel to cut a small hole in the center of the bottom of the tin can. Drive the center wooden core out longitudinally using a dowel of good size as a driving punch. Enlarge the cold chisel hole in the bottom of the tin can with a file, bringing it up to the full size of the bore hole. Cut a hole in the outside wall of the tin can opposite the dowel pin which was left for the clamp bolt hole. Drill out this dowel pin. If a hollow piece of metal tube has been used, the clamp bolt hole will already be open. If leakage has occurred, a little filing or reaming may be needed, and it may be advisable to run the tap through the threads of the insert again. Try out the clamp bolt to see that it works. Cut off the upper end of the tin can, down to about 3/16 of an inch above the top of the lead. Tin shears or a hacksaw will make a neat job. Hammer this tin edge over gently all around the top edge of the lead. This serves to eliminate any sharp edge of tin on which one might scratch oneself. It also gives a slightly rounded edge to the weight for a finished appearance. A wooden mallet will avoid denting the underlying lead.



The counterweights pictured on page 15 are here shown mounted on and clamped to a declination axis.

One now has a counterweight sheathed in tin except for the center portion of the top, which shows a surface of lead. Try the counterweight on the mounting. It may prove necessary to file out the center hole a little with a rattail file or to do a little trimming with a knife blade. When the counterweight works well mechanically, paint it to produce a neat-looking and serviceable job.

D. W. ROSEBRUGH
87 Fern Circle
Waterbury 69, Conn.

RAMSDEN EYEPIECES
$4.20 each
Professional Make — Excellent Optics
Brass mounts, 1¼" dia., easily cleaned, 1", ½", ¼" equivalent focal lengths
Low prices on 5" and 6" achromat blanks. Send for information.
DE PALMA OPTICAL CO.
13031 Oxnard Blvd., Van Nuys, Calif.

EYEPIECE AND OBJECTIVE BARGAINS
Send for Free List
F. W. BALLANTYNE
P. O. Box 382
Point Pleasant New York

Popular Size Refracting and Reflecting TELESCOPES
EQUATORIAL MOUNTINGS & ALL TELESCOPE PARTS
Price List Folder on Request
J. M. SCOPEMASTER
337 E. 81 St., New York 28, N. Y.

THE BRITISH INTERPLANETARY SOCIETY
(Limited by Guarantee)
157 Friary Road, London, S. E. 15
Membership is open to all interested in astronautics and rocket development. The Society issues a bi-monthly Journal and a yearly Annual Report and List of Members. Lectures, film displays, and visits to observatories and scientific laboratories are also arranged.
Particulars of membership and fellowship and specimen copies of the Society's publications will be sent free of charge to interested persons.
Address all communications to the Secretary at the address shown above.

13-INCH SETTING CIRCLES

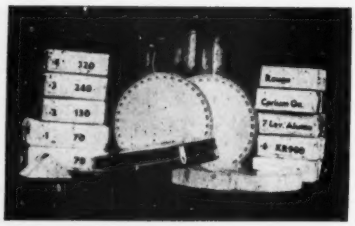
OBSERVERS — EQUIP YOUR MOUNTINGS WITH CO-ORDINATE CIRCLES
$35.00 a pair
With these large, finely made circles carrying 1440 divisions each, you can instantly find stars and nebulae that are invisible to the naked eye and also identify them from the catalog.
1. Set declination of star first. 2. Set the time circle (upper graduations) to the right ascension of the star with the telescope stationary. 3. Now move the telescope carrying the time circle until the lower graduations read your local sidereal time. The star will be centered in your low-power eyepiece. Free instructions and sidereal-time formula.
To identify a star: While it is in the telescope, move the time circle to sidereal time and take readings of the R. A. and Dec. Then compare with the star catalog.

ELECTRIC SIDEREAL CLOCK

Sidereal time is required for the positive location and identification of celestial bodies visible or invisible to the naked eye.
This clock has gears that give a computed rating of less than six minutes slow in a century. Cast aluminum base, bronze front bezel, 4" minute circle, metal dial. Hands may be set from the front or back. 110 volts 60-cycle or 50-cycle on request. Good for all climates. **$36.00.**
Observers wishing to convert their standard clocks to sidereal may do so under our free instruction. The cost of gear changes is about $5.00. 24-hour dials may be had directly from John Stofan, 332 Herrick Ave., Teaneck, N. J., at a cost of $1.00 each.

Haines Scientific Instruments
Box 171, Englewood, New Jersey
Telephone: ENglewood 3-3441-J

New Low Prices on PYREX Reflecting Telescope Kits



Two circle dials with every Pyrex Kit.

The most complete kits on the market. In addition to the usual supply of abrasives, rouge, etc., you get the new, fast-polishing cerium oxide to save hours of work. You can get a brass diagonal holder (spider) for only $1.00 additional if ordered with a telescope kit. Prices quoted below are for a Genuine Pyrex telescope blank and a plate glass tool.

PYREX MIRROR KITS

4"	$ 5.25	6"	$ 6.75
8"	9.75	10"	16.75
12½"	31.75	16"	65.00

4" to 16" PYREX CARRIED IN STOCK

PLATE GLASS KITS

6" x ¾"	$4.75	6" x 1"	$ 5.25
8" x 1"	7.25	9¾" x 1½"	12.50

Postage Paid to 1st and 2nd postal zones from N. Y. Add 5% 3rd and 4th zones, 10% 5th and 6th zones. Add 15% 7th and 8th zones.

Parabolic pyrex mirrors made to order.

Send for free catalog of optical supplies.

DAVID WILLIAM WOLF

334 Montgomery St. Brooklyn 25, N. Y.

Immediate Delivery

LAMINATED PLASTIC

TELESCOPE TUBES

Made of tough, laminated Synthane, a technical plastic weighing only half as much as aluminum. Strong. Dimensionally stable. Easy to machine. Has low moisture absorption, and a very low coefficient of expansion. Good heat insulator.

100% black. May be painted but tube itself is solid black **all the way through,** not only on surface.

Now available in 8" inside diameters, lengths 50" to 55" (specify length), wall thicknesses ⅛".

SYNTHANE Corporation

OAKS, PENNSYLVANIA

SKY-SCOPE

The new and improved 3½-inch Astronomical Telescope that amateurs everywhere are talking about.

Completely Assembled — Not a Kit

Equatorially Mounted, 60 Power

¼-wave Aluminized Mirror

Ramsden Type Ocular

Price $25.00 plus expressage

We invite your attention to our free brochure describing in a straightforward manner the instrument's amazing performance.

THE SKYSCOPE CO., INC.

475-a Fifth Avenue, New York 17, N. Y.

A Patrol Camera Gift

The professional astronomer was recently aided by the amateur when the Columbus Astronomical Society presented a patrol camera to the Perkins Observatory, of Ohio State and Ohio Wesleyan universities. The instrument is equipped with a Zeiss 105 CM apo-planar lens of about 17½ inches focal length. On 8 by 10 plates an area of about 20 square degrees can be photographed.

The camera is made of 3/16" aluminum plate with aluminum alloy castings holding the lens; there is screw adjustment to permit lenses of 15 to 22 inches focal length being used. The declination and polar axes are both mounted in ball bearings, but a brake had to be installed on the declination axis to overcome wind pressure.

Designed and constructed by the Barber-Colman Company, the motor drive consists of a 3,600 r.p.m. synchronous motor with a built-in gear reduction of 14,400 to 1. The bronze polar axis gear has 359 teeth, driven by an 8-thread single lead worm gear. The large gear was made on a lathe using a ¾" reamer to cut a chase for the teeth and a ¾" No. 8 tap to cut the teeth. A cork insert clutch is provided to engage the motor drive, but it is seldom used, as the drive has a flexible coupling and is spring loaded so the teeth will jump if too much pressure is exerted on the camera. In operation, this driving worm is disengaged and the camera located by the setting circles, the worm released, and the power turned on.

This instrument was made in my home shop, with much of the work done by Robert Misener and Frank A. Paulus.

L. R. STEWART
138 Arden Road
Columbus 2, Ohio

Members of the Columbus Astronomical Society and a patrol camera they constructed and turned over to Perkins Observatory for professional operation. Left to right are L. R. Stewart, Robert Misener, and Frank A. Paulus.

Letters

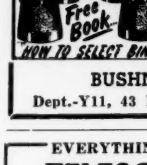
(Continued from page 2)

shone a nebulous semicircle — phosphorescent, with stars tangled in it. From this crescent of light were effused to north and west and east rays, bands, foam-flakes, belts, spears, shafts of changeful hues, now rosy red, now brightening into amethyst, now green, now pale as ashes. The whole was in slow and solemn movement, like lightning congealed, which has not ceased to throb. As glaciers are to running water, so were these auroral flames to the quivering of lightning. In the midst of all the glow and glory sparkled Ursa Major, calm and frosty. Other stars seemed to wander in the haze, as I have seen them in a comet's tail. The most wonderful point in the pageant was when the crescent flamed into intensely brilliant violet. Then it faded; the whole heaven for a few moments flushed with diffused rose — but the show was over."

L. L. RICE
Ware Neck, Va.

Binoculars for X'mas! Order Now. Quantity Discounts.

SAVE UP TO 50% BINOCULARS DIRECT From IMPORTER



THE WORLD'S GREATEST VALUES

GERMAN ENGINEERED, BRAND NEW, DELUXE LEATHER CASE INCLUDED. Each instrument precision built to rigid military specifications. Buy direct at lowest unheard of prices! **Free Catalog.** Lifetime guarantee. Use at our risk and expense.

6 x 15	$18.00	with Coated Optics $19.50
8 x 30	33.00	with Coated Optics 39.50
7 x 50	42.50	with Coated Optics 49.50
10 x 50	52.00	with Coated Optics 62.00

Many other models. Largest Stock in the West. **ORDER TODAY!** Send check or money order. $2.00 Deposit on COD's. **MONEY-BACK GUARANTEE!**

Free Book "HOW TO SELECT BINOCULARS" Add 20% Fed. Tax. Postage Included

BUSHNELL IMPORTERS

Dept.-Y11, 43 E. Green, Pasadena 1, Cal.

EVERYTHING FOR THE AMATEUR

TELESCOPE MAKER

KITS 6"—$5.50 up; Pyrex, 6" ... $7.50 up. Other sizes in proportion.

ALUMINIZING

Superior Reflecting Surface, Fine Finish. Will not Peel or Blister. Low Prices.

Mirrors Tested Free | **Prisms Eyepieces Accessories** | **Send for Free Catalog**

MONEY BACK GUARANTEE

Precision Optical Supply Co.

1001 E. 163rd St., New York 59, N. Y.

OBSERVER'S PAGE

Universal time is used unless otherwise noted.

The Eclipse of the Moon Is Widely Observed

ALTHOUGH bad weather or the threat of it interfered greatly in some localities, the eclipse of the moon on the evening of October 6th was observed by amateurs in most parts of the United States, according to reports in hand as we go to press (October 10th). There is general agreement that the eclipse was neither especially light nor dark, and that the colors were more striking than in April.

From Portsmouth, Va., G. R. Staples writes that a heavy overcast broke just in time — the sky cleared about a half hour before totality and clouded over again soon after. Rain fell before and after the eclipse. Some parts of the moon varied from light to dark at intervals, this effect taking place mostly on the southern edge.

On the West Coast, where the moon rose in partial eclipse, Lewis Lindsay reports his observing post as at an altitude of 2,600 feet near the peak of Mt. Tamalpais, 10 to 12 miles northwest of San Francisco. Observing co-operatively with him was David W. Minto, at sea level at Mill Valley directly by the base of the mountain. They found that the movement of shadows and the shifting of light and dark areas across the face of the moon were close in timing and general design, but the sea-level observations presented a deeper range of colors.

At 2,600 feet, only very light shades of peach and smoke pink were seen along the top rim and the upper areas of the disk, while the lower surface presented a fairly light field of dull white tinged slightly with red. At sea level, in place of the pale pink areas, there were definite casts of red, and a well-defined shade of yellow appeared upon the lower rim and spread upward into the dull white. As seen from the upper station near the end of totality, the globular appearance of the moon stood out unusually well.

Mrs. Albert M. Bonelli, of Vicksburg, Miss., was pleased with the weather and the eclipse: no clouds and no mosquitoes. A crowd gathered in her back yard and stayed over an hour. The eclipsed moon reminded her of an agate marble.

At Amityville, Long Island, N. Y., Peter Leavens saw 15 minutes toward the end of totality in the clear after thick layers of clouds had broken. The portion of the moon deep in the shadow was ruddy; the limb nearest the shadow's edge had a greenish hue.

From Salem, Ore., Carl P. Richards reports that October 6th was a day of much rain, with a heavy thunderstorm in the afternoon. Nevertheless his party of seven went to their observing site on the Eola Hills, 400 feet above the city, and soon after 6:00 p.m. observed Jupiter and Vega and a few other stars. Moonrise was at 5:35 and sunset at 5:44 PST. It was not until 6:35 that the dim, totally eclipsed moon was faintly seen through a bank of breaking clouds. It disappeared, however, until 7:00, after which it was a superb sight in a clearing sky. He describes the moon as a beautiful coppery-red disk, almost metallic in luster, with the lower edge a pale crescent of pearly light.

William I. Barnholth, of Akron, Ohio, works evenings until midnight, and was not able to change his hours because of the eclipse. He contented himself with looking out of the window now and then while at work. But it was rainy and cloudy in Akron. Mr. Barnholth explained to some of his fellow workers that an eclipse can take place only at full moon. About 9:00 p.m. one of them said the moon was a crescent, not full, but this was the effect of the partial eclipse. Momentarily it had cleared, but it clouded again until about 9:40, when what looked like a full moon was observed. For a while there seemed to be a mystery, but Mr. Barnholth later realized that the contrast of the eclipsed moon behind the clouds made the moon look as if it were full, but dimly seen.

At Boston, Mass., the sky was as clear as it had been for the eclipse in April, not a single cloud being visible at any time. A crowd of nearly two thousand people gathered on Boston Common for observing through telescopes set up and manned by the Amateur Telescope Makers of Boston. The party was arranged by the Boston Museum of Science. Late that evening observers in the suburbs of the city were treated to a good display of the northern lights.

Aurora observations the night of the eclipse were also made by Paul A. Smith at Geneseo, Ill., Ralph A. Wright at Worcester, Mass., and Paul W. Stevens at Rochester, N. Y.

Mr. Wright reports that an eclipse party was held at the Worcester Museum of Natural History nature camp in Paxton. Before and after first and last contact, he noticed a circular shaded spot about one third the moon's diameter near the points of contact. Also, he noted a faint shadow or band about one eighth the moon's diameter preceding the umbral shadow during the first stage of the eclipse, and following it during the final stage. This band was yellow near the edge, shading to gray as it contacted the shadow. There was no yellow to the band after last umbral contact, but only shades of gray.

Mr. Stevens and fellow observers were plagued by clouds, but at 7:15 p.m. EST they had a chance to see the mutual conjunction of three of Jupiter's satellites. At one time the Jovian moons were so close together they looked almost as one with low power. The penumbral phase was seen to advantage, with a noticeable diminution of light on the eastern limb as early as 7:45 p.m. For half an hour after 10 o'clock, the Rochester amateurs had a good view of the total eclipse.

MOON PHASES AND DISTANCE

Full moon	November	5, 21:09
Last quarter	November	13, 15:47
New moon	November	20, 7:29
First quarter	November	27, 10:01
Full moon	December	5, 15:13

	November		Distance	Diameter	
Apogee	3d	18h	252,300 miles	29′	26″
Perigee	19d	2h	223,400 miles	33′	14″

Now! Saturn 3 Inch PORTABLE REFRACTORS

Only $199.00

For the first time an instrument capable of serious astronomical research is available for less than $200.00! The Saturn 3 Inch Portable Refractors are precision made by the West's largest makers of observatory instruments; objective lenses are highest grade precision ground, achromatic f-15 crown and flint glass, all moving parts are precision machined.

Although the Saturn 3 Inch Refractor has a 45 inch focal length, the instrument is easily portable, weighing less than thirty pounds, including tripod.

Saturn 4 Inch Portable Refractors from $345.00; larger instruments manufactured to order.

Write for literature giving full information on the Saturn Refractors.

Tinsley

2530 Grove Street
Berkeley, California

something new for stargazing . . .

STARSCOPE

A new system for constellation study . . . the STARSCOPE is held to one eye while the other eye is directed toward the corresponding group of stars in the sky. The effect is a projection on the heavens identified by name and with the mythological figures outlined. The charts are interchangeable, of course, and keyed from the North Star so as to cover the entire sky seen from the Northern Hemisphere — and the planets by dated positions as well. Printed instructions. Complete with spare battery, postpaid $3.95

The Starscope is offered on ten-day return privilege

POLARIS D. AND M. COMPANY
Linden Missouri

A NEW SERVICE

24 35-mm. astronomical slides—10 chart slides —14 Mt. Wilson pictures—in sturdy glass mountings ..... postpaid $8.50 per set

ASTRONOMY CHARTS

The set of 25 charts, 8½ x 11, punched for looseleaf folders ..... postpaid $3.00
Single Wall Charts 27 x 35 inches (duplicates of the small charts) ..... each $3.00

Circular? Drop us a card.

ASTRONOMY CHARTED
4 Mason Street, Worcester 2, Mass.

WE REPAIR

★ *Microscopes* ★ *Telescopes*
★ *Field Glasses* ★ *Binoculars*

WE BUY, SELL, EXCHANGE OPTICAL AND SCIENTIFIC INSTRUMENTS

WAELDIN 10 Maiden Lane New York City BEekman 3-5393

SKY-GAZERS EXCHANGE

Classified advertising costs 8 cents a word, including address; minimum charge $2.00 per ad. *Remittance must accompany order.* Insertion is guaranteed only on copy received by the first of the month preceding month of issue; otherwise, insertion will be made in next available issue. We cannot acknowledge classified ad orders. Write Ad Dept., Sky and Telescope, Harvard Observatory, Cambridge 38, Mass.

EXCELLENT 10″ reflector, f/8 (79¾″ f.l.), in cell, aluminized, and diagonal. Best price takes it. Write Rev. J. A. Stevenson, 4827 N.E. 19th Ave., Portland 11, Ore.

FOR SALE: 16-inch telescope lens, John Brashear of Pittsburgh make. Double-convex and concavo-convex lenses of crown and flint, focal length 26 feet. Mounted in steel frame ready to install. Robert M. Cole, Bryn Athyn, Pa.

BUSCH 29x telescope, 1⅞″ diameter achromatic objective, complete with lens shade, cap, leather carrying case. Used but in good condition—$24.00. H. Wirth, 4707 39th Ave., Long Island City 4, N. Y.

FOR SALE: Volumes 1-5 of "The Sky." Volumes 1-6 of "Sky and Telescope." Perfect condition, unbound, $55.00. Jesse Selover, 6 Virginia St., South River, N. J.

FOR SALE: 10″ aluminized parabolic mirror, focal length 86″. Optical satisfaction guaranteed, but aluminum coating is slightly deteriorated. $60.00. James Bray, 860 Walnut Ave., Burlingame, Calif.

THEODOLITE: Japanese military, 10 x 6° prismatic telescope. Collector's item in beautiful condition with compact case at $79.00. Write for picture and details. Also 100x fluorite 1.8-mm. B&L oil immersion microscope objective worth $90.00 at $59.00. H. E. Paul, Norwich, N. Y.

FOR SALE: Mounted 4″, 5″, and 6″ refractor objectives of first quality. $60.00, $180.00, and $300.00. Correspondence invited. Earl Witherspoon, Sumter, S. C.

PYREX MIRRORS made to your order unaluminized, 4¼″, 6″, 8″, and 10″ diameters. $13.00, $27.00, $42.00, and $68.00, respectively. Paul Chorley, 143 Edgemont Ave., Vallejo, Calif.

ELECTRIC DRIVES with clutch and mounting bracket made to suit your telescope. $60.00 F.O.B. Inquiries invited. Fellows Engineering Works, Middle Haddam, Conn.

TELESCOPES: Bausch and Lomb 13 to 60 power. Also Saturn, Argus, and Mossberg scopes. Write for booklets and prices. Frank Smatlak, 810 Lakeview Ave., Rice Lake, Wis.

REFRACTOR, 5″ objective, 7 oculars, high power, reasonable. To inspect write Penthouse 16A, 675 West End Ave., New York 25, N. Y., or ..phone Riverside 9-3243.

TRACKS OF ECLIPSES

Circular No. 1 of the U. S. Naval Observatory, dated July 18, 1949, gives the tracks of the total eclipses of the sun that occur in 1952 and 1954. No desirable eclipses occur in 1951 or 1953. It is planned eventually to publish these eclipse paths annually eight years in advance, in order that suitable sites for eclipse expeditions may be determined.

The eclipse of February 25, 1952, crosses Africa and Asia. That of June 30, 1954, starts in Nebraska, crosses Minnesota near Minneapolis and St. Paul, passes near the foot of James Bay, and out across Labrador to the tip of Greenland. It continues over Norway south of Oslo, across Sweden and Russia, to Iran and India.

The positions of the track of totality given in the circular as far as Greenland are:

UT	*Lat.* ° ′	*Long.* ° ′	*Dur.*	*Path*
11:08	42 22.0	99 04.5		
11:10	47 58.9	86 55.6	84	76
11:15	52 13.7	76 58.6	97	82
11:20	54 57.7	69 41.1	107	85
11:25	57 01.5	63 18.5	114	87
11:30	58 39.3	57 22.2	121	88
11:35	59 57.3	51 40.4	127	90
11:40	60 59.0	46 07.5	132	91
11:45	61 46.2	40 40.8	137	91

UT is Universal time; *latitude* is north; *longitude* is west; *duration* is in seconds, along central line; *path* width is in miles.

METEORS IN NOVEMBER

The **Handbook** of the British Astronomical Association lists two meteor showers this month, the Taurids and the Leonids. Maximum for the first swarm is given as November 3-10, with normal limits between October 26th and November 22nd. The hourly rate at maximum is six, and the diffuse radiant is located at R.A. 55°, Dec. +15°. The moon interferes, except in the later stages of the shower.

The maximum of the Leonid shower, consisting of faint, high-speed meteors, will occur on November 16th, with normal limits between November 15th and 20th. The hourly rate at maximum is only six, but the moon will not interfere at all and one should be able to determine the radiant from a few hours' observing. It is located at R.A. 152°, Dec. +22°.

MINIMA OF ALGOL

November 2, 14:50; 5, 11:39; 8, 8:27; 11, 5:16; 14, 2:05; 16, 22:54; 19, 19:43; 22, 16:32; 25, 13:21; 28, 10:10. December 1, 6:59; 4, 3:48; 7, 0:37; 9, 21:26.

These predictions are geocentric (corrected for the equation of light), based on observations made in 1947. See **Sky and Telescope,** Vol. VII, page 260, August, 1948, for further explanation.

VARIABLE STAR MAXIMA

November 5, SS Virginis, 6.9, 122001; 7, R Ursae Majoris, 7.6, 103769; 8, T Normae, 7.4, 153654; 9, V Bootis, 7.9, 142539a; 14, R Draconis, 7.6, 163266; 19, RU Sagittarii, 7.2, 195142. December 3, T Aquarii, 7.9, 204405.

These predictions of variable star maxima are made by Leon Campbell, recorder of the AAVSO. Only stars are included whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0. Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

OCCULTATION PREDICTIONS

The occultation of Saturn on the morning of November 15th will be observable across the continent from Station **A** in Massachusetts to Station **G** at Calgary, but it will occur after sunrise for everyone except those in the Far West. It will be preceded, of course, by a close configuration of the 24-day-old crescent moon and the planet, which is of the 1st magnitude. Telescopically, it should be possible to observe both the immersion on the bright side of the moon and the emersion on the dark side.

November 9-10 **49 Aurigae** 5.0, 6:32.0 +28-03.8, 19, Im: **A** 5:56.5 −1.8 +0.2 107; **C** 5:47.6 −1.9 −0.1 114; **E** 5:28.2 −1.0 +1.1 93; **F** 5:13.8 −1.0 +0.4 109; **H** 5:14.3 +0.4 +1.6 63. Em: **A** 7:17.3 −2.0 +1.4 250; **B** 7:18.6 −1.9 +0.8 262; **C** 7:02.1 −1.8 +2.3 238; **D** 7:06.1 −1.7 +1.3 257; **E** 6:42.4 −1.3 +1.7 254; **F** 6:16.9 −0.6 +2.4 233; **G** 6:24.3 −1.3 −0.1 317; **H** 6:11.1 −0.6 +0.9 281; **I** 6:12.4 ... ... 330.

November 10-11 **Upsilon Geminorum** 4.2, 7:32.8 +27-00.7, 20, Im: **C** 7:44.3 −1.9 +3.2 52; **E** 7:30.0 ... ... 36; **F** 6:57.8 −0.8 +1.9 67. Em: **C** 8:42.9 −1.9 −3.2 329; **E** 8:10.9 −2.2 −3.5 336; **F** 8:10.0 −2.1 −0.5 298.

November 14-15 **SATURN** 1.2, 11:17.5 +6-32.0, 24, Im: **A** 13:29.7 −1.2 −1.6 134; **B** 13:23.9 −1.2 −1.4 130; **C** 13:31.1 −1.0 −2.0 149; **D** 13:20.1 −1.0 −1.7 144; **E** 13:19.7 −0.2 −3.0 177; **G** 12:44.8 −0.3 −2.4 176. Em: **A** 14:41.7 −1.1 −1.7 305; **B** 14:35.6 −1.0 −1.7 307; **C** 14:41.5 −1.5 −1.4 292; **D** 14:31.5 −1.4 −1.4 295; **E** 14:12.0 −2.7 +0.1 263; **G** 13:27.4 −1.9 +2.0 253.

November 14-15 **Sigma Leonis** 4.1, 11:18.5 +6-18.5, 24, Im: **G** 13:36.8 ... ... 195. Em: **G** 14:02.0 ... ... 237.

December 6-7 **49 Aurigae** 5.0, 6:32.0 +28-03.8, 17, Im: **H** 13:49.1 −1.6 +0.2 53. Em: **H** 14:30.0 +0.8 −2.9 334.

For standard stations in the United States and Canada, for stars of magnitude 5.0 or brighter, all data from the **American Ephemeris** and the **British Nautical Almanac** are given here, as follows: evening-morning date, star name, magnitude, right ascension in hours and minutes, declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, UT, **a** and **b** quantities in minutes, position angle on the moon's limb; the same data for each standard station westward.

The **a** and **b** quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude, respectively, enabling computations of fairly accurate times for one's local station (long. **Lo,** lat. **L**) within 200 or 300 miles of a standard station (long. **LoS,** lat. **LS**). Multiply **a** by the difference in longitude (**Lo — LoS**), and multiply **b** by the difference in latitude (**L — LS**), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Universal time to your standard time.

Longitudes and latitudes of standard stations are:

A	+72°.5, +42°.5	**E**	+91°.0, +40°.0
B	+73°.6, +45°.6	**F**	+98°.0, +30°.0
C	+77°.1, +38°.9	**G**	+114°.0, +50°.9
D	+79°.4, +43°.7	**H**	+120°.0, +36°.0
		I	+123°.1, +49°.5

THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.

Mercury remains in the vicinity of the sun all month. It passes superior conjunction with the sun on the 21st, entering the evening sky at that time.

Venus attains greatest elongation on November 20th, 47° 15′ east of the sun. The planet may be found in the southwest for three hours after sunset, but near the horizon. From the Southern Hemisphere, Venus will be ideally located, its south declination of 26° making it visible for a longer time and at a higher altitude. The planet grows brighter during the month. It is traversing Sagittarius. At elongation, Venus will be 50 per cent illuminated; the diameter is 25″, and the magnitude −4.0.

The moon passes 2° south of Venus on the 23rd, at 19:10 UT. One should be able to locate Venus in the daytime without optical aid. Look near the meridian at about 3 p.m. local time; the moon will aid in finding the planet on the 23rd.

Mars rises shortly after midnight, and is moving eastward in Leo. Mars passes slower-moving Saturn on November 30th at 21:00, the former being 9′ north. The planets are approximately the same brightness.

Jupiter, visible only in the evening hours, is to be found east of Venus.

Saturn, located in Leo, with Mars, is of no unusual interest to the naked eye. With telescopic aid, the ring system may be seen tilted only 2° to the plane of the ecliptic, and slowly closing.

Uranus comes to opposition next month, and hence it is above the horizon most of the night. It is in western Gemini, and retrograding past Mu (+3.2), the planet about 1° 6′ north. The magnitude is 6th.

Neptune may be found before dawn, about 1½° west of Theta Virginis. E. O.

JUPITER'S SATELLITES

November 1, 32104; 2:51 I Oc, 4:50 II Oc. **2,** 34012; 0:08 I Tr, 1:24 I Sh, 2:24 IV Sh, 2:25 I TrE, 3:41 I ShE, 23:23 II Tr. **3,** 430; 0:53 I EcR, 1:52 II Sh, 2:09 II TrE, 3:50 III Oc, 4:40 II ShE. **4,** 42103; 23:39 II EcR. **5,** 40213. **6,** 41023; 22:58 III Sh. **7,** 42301; 2:34 III ShE. **8,** 43210; 4:48 I Oc. **9,** 34012; 2:06 I Tr, 3:20 I Sh, 4:23 I TrE, 5:37 I ShE, 23:18 I Oc. **10,** 3402; 0:28 IV Oc, 2:04 II Tr, 2:48 I EcR, 4:28 II Sh, 4:47 IV OcR, 4:50 II TrE, 22:53 I TrE.

November 11, 21034; 0:06 I ShE. **12,** 0134; 2:17 II EcR. **13,** 10234. **14,** 2014; 1:44 III TrE, 3:00 III Sh. **15,** 32104. **16,** 30124; 4:05 I Tr. **17,** 31024; 1:16 I Oc, 4:44 I EcR, 4:46 II Tr, 22:35 I Tr, 23:45 I Sh. **18,** 2043; 0:52 I TrE, 2:02 I ShE, 23:12 I EcR, 23:42 II Oc. **19,** 4013; 1:13 IV ShE, 4:55 II EcR. **20,** 41023; 23:10 II ShE.

November 21, 42031; 2:27 III Tr. **22,** 43210. **23,** 43012. **24,** 43102; 3:15 I Oc. **25,** 4201; 0:35 I Tr, 0:41 III EcR, 1:40 I Sh, 2:52 I TrE, 3:58 I ShE. **26,** 4203; 1:07 I EcR, 2:29 II Oc, 22:27 I ShE. **27,** 1023; 0:28 IV OcR, 22:57 II Sh, 23:40 II TrE. **28,** 20314; 1:46 II ShE. **29,** 32104. **30,** 30214.

December 1, 2014. **2,** 21034; 0:33 III OcR, 1:02 III Ec, 2:35 I Tr, 3:36 I Sh, 23:45 I Oc. **3,** 0243; 3:03 I EcR, 23:23 I TrE. **4,** 02143; 0:22 I ShE, 23:38 II Tr. **5,** 24310; 1:33 II Sh, 2:26 II TrE, 4:23 II ShE. **6,** 4301; 23:30 II EcR. **7,** 43102. **8,** 42301. **9,** 42103; 1:19 III Oc. **10,** 40123; 1:46 I Oc, 23:07 I Tr.

In the accompanying data, taken from the American Ephemeris and Nautical Almanac, following each date (in bold-face type) are given the telescopic satellite positions west (left) or east (right) of Jupiter (which is designated 0) at 0:00 UT in November, and at 23:00 in December.

Then are given the Universal time, the satellite (Roman number), and the phenomenon. Tr and TrE are the beginning and ending, respectively, of a satellite transit; Sh and ShE, same for the shadow; Ec and EcR are eclipse disappearance and reappearance, respectively; Oc and OcR, same for occultation.

OBSERVING JUPITER'S SATELLITES

On September 23rd I observed a very interesting sight. At 9:30 p.m. Eastern daylight time I set up my 4-inch refractor and began studying Jupiter. Previously, on checking the **Observer's Handbook,** I had found that satellites **III, II,** and **IV** were to the east of the planet and **I** was in transit. Observing first with 60 power I could see only two satellites to the east.

After checking the positions in the September **Sky and Telescope,** I took another look, this time with 120 power, and discovered that **II** and **III** were at this time an extremely close double. Later in the evening they began to separate, but I imagine that earlier they appeared almost as one, even with high power. Keeping track of the moons of Jupiter is certainly one of the more fascinating aspects of amateur astronomy. It would be interesting to know if any other amateurs had observed this unusual configuration.

Incidentally, I liked the old way of showing Jupiter's satellite positions on a diagram better than your present method. I can get the eclipse, transit, shadow transit, and occultation times from the **Observer's Handbook,** but never know what the relative positions in respect to the planet will be. How about going back to the old way next year?

EDWIN V. GREENWOOD
454 Willard Ave.
Toronto, Canada

ED. NOTE: Several subscribers have indicated their preference for the charts formerly used for Jupiter's satellites. Next year we shall return to that method unless enough readers express a preference for the present information. Please let us have opinions on either side.

BINDERS

for SKY AND TELESCOPE

File each issue as it comes . . . a new type of binder holds a year's issues . . . opens flat for quick use of your magazines . . . dark blue fabrikoid with SKY AND TELESCOPE gold-stamped on cover and back . . . reuse from year to year or keep each volume permanently bound in this form . . . **$2.95** **postpaid**
($3.50 in Canada)

Orders accepted for delivery in the United States and Canada only. Payment must accompany your order.

If you wish, your name gold-stamped, 50 cents extra; volume number, 30 cents; both, 75 cents. Please print the desired lettering clearly.

SKY PUBLISHING CORPORATION
Cambridge 38, Mass.

The sky as seen from latitudes 30° to 50° north, at 9 p.m. and 8p.m., local time, on the 7th and 23rd of November, respectively.

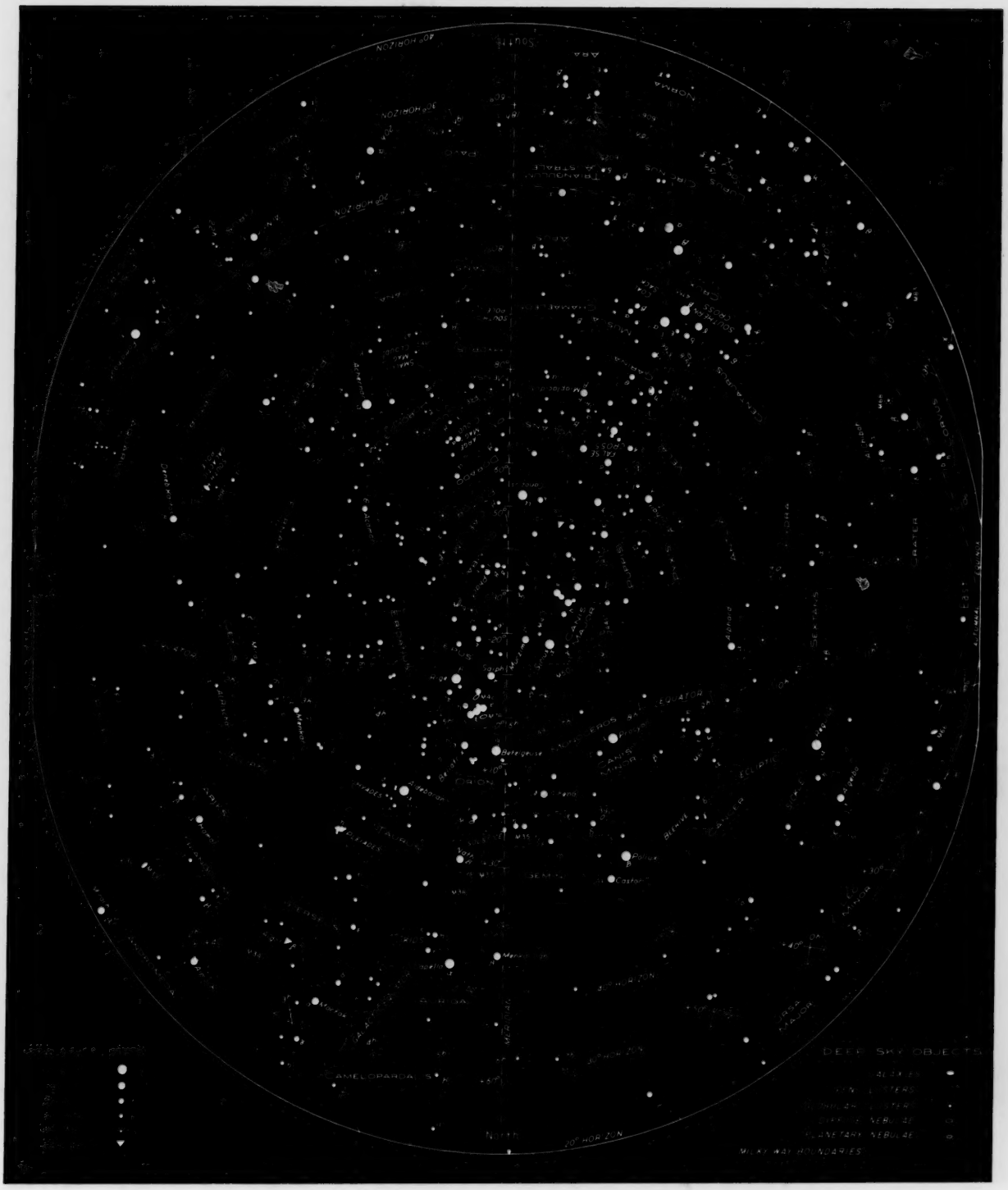
STARS FOR NOVEMBER

PEGASUS' Great Square dominates the sky these fall evenings, the centroid of an interesting array of ancient constellation patterns. A modern idea is to regard the corners of the Great Square as bases on a baseball diamond, with Markab home plate and Alpheratz, in Andromeda, as second base. On this basis, flag poles along the foul lines are Eta (η) Piscium and Omicron Andromedae. Out in center field is the Great Nebula in Andromeda, M31, 750,000 light-years beyond the stars that make this local configuration.

Persons imbued with our national pastime can find endless additions to this baseball pattern idea. For instance, a wild throw from third base (Algenib) to home might land in the players' dugout, marked by Enif, in the nose of the Winged Horse. A throw from first base (Scheat) to home would have to be terrifically wild to go relatively as far as Fomalhaut, which lies far to the south of the Great Square.

A variation of this arrangement is to call one of the other stars home plate; for instance, if Algenib is chosen, then Deneb is the center fielder playing very deep.

CHART CORRECTION: In this chart the labels for Beta (β) and Gamma (γ) Lyrae should be reversed.



The sky as seen from latitudes 20° to 40° south, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of February, respectively.

SOUTHERN STARS

SOUTHERN HEMISPHERE observers may study in their summer skies of February the brilliant stars near the Milky Way known as Gould's Belt, whose principal parts lie stretched across this month's chart. This band was first noted by John Herschel, who remarked on its non-coincidence with the Milky Way. Composed mainly of bright stars of early spectral class (type **B**) that stretch from Orion through Canis Major and Columba, Puppis, Carina, Crux, Centaurus, Lupus, and into Scorpius, the band continues around the northern hemisphere of the sky, but is much less marked.

Because this belt of bright stars does not coincide with the plane of the Milky Way galaxy itself, in 1879 B. A. Gould suggested that these stars must be "part of a smaller cluster, distinct from the vast organization . . . which forms the Milky Way." The existence of this "local system" has been accepted since, but more recent interpretations favor the existence of several local knots of stars.

Students of the Milky Way are gradually building up a picture of the sun's position in the galaxy and among its local neighbors by studies of the numbers, brightnesses, and distributions of stars such as the group called Gould's Belt.